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NAVAL SHIPS' TECHNICAL MANUAL

CHAPTER 582

MOORING AND TOWING

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NOTE

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CHAPTER 582

MOORING AND TOWING

PART 1

MOORING

SECTION 1.

GENERAL MOORING INFORMATION

582-1.1 SHIP MOORING LINES

582-1.1.1 MOORING LINES. Mooring lines are used to secure a ship to a wharf, pier, dock or another ship. Six-inch circumference or smaller mooring lines are used by cruisers, destroyers, minesweepers, tugs, and other small ships. Ships, such as large auxiliaries, battleships and aircraft carriers, use 8-inch or 10-inch circumference lines. Mooring lines of nylon or polyester are used most often.

582-1.1.2 NUMBERING OF MOORING LINES. Mooring lines are numbered from forward to aft according to the position where they are secured aboard the ship. A ship may use more mooring lines under heavy weather conditions, in which case the numbers are changed. Figure 582-1-1 shows the names and numbers for seven mooring lines used for a typical pier side moor.

582-1.1.3 TYPES OF MOORING LINES. The mooring line at the stem of the ship is called the bow line. On surface ships the bow line is usually run through the bow chock. The corresponding line aft is the stern line. On surface ships the stern line is usually run through the stern chock. The bow and stern lines are usually lead up the dock to hold the ship against the pier or wharf. The other mooring lines are called either breast or spring lines. Spring lines lead diagonally from the ship to the dock and control the fore and aft motion of the ship. Breast lines are run perpendicular to the center line or keel of the ship and hold the ship next to the pier. The mooring lines are named according to their position on the ship and how they lead from the ship. For example, in Figure 582-1-1 the number two line is called an after bow spring line because it is located on the bow and it is a spring line leading aft.

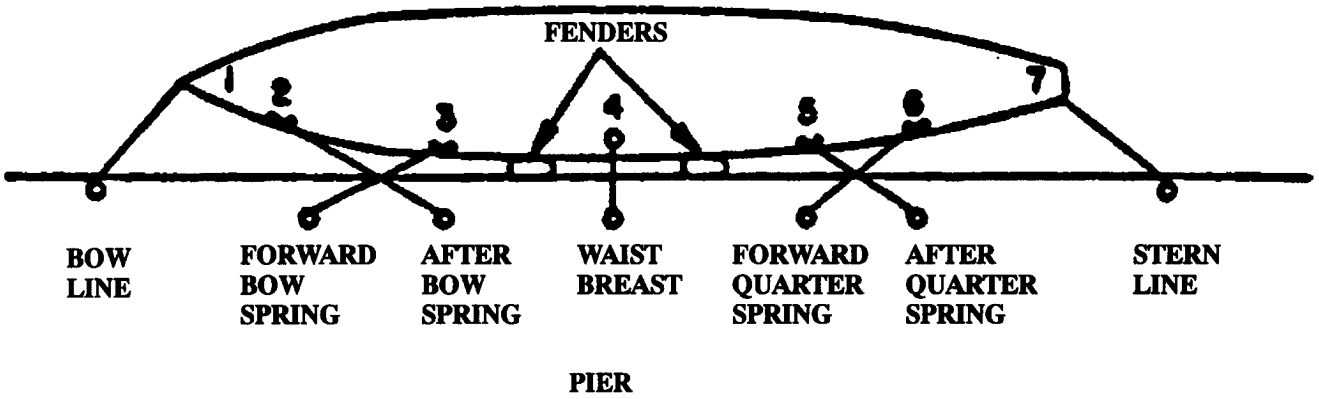


Figure 582-1-1 Mooring Line Nomenclature

582-1.2 ARRANGEMENT AND USE OF MOORING LINES

CAUTION

A ship's mooring lines are sized for the loadings imposed on the lines when securing the ship to the pier or wharf. When ships are moored in a nested arrangement, additional lines should be run from the out board ship(s) to the pier or wharf. The inboard ship (the one next to the pier) should put out additional mooring lines to compensate for the loads imposed on it by the outboard ship(s). If heavy weather is anticipated, alternative mooring arrangements to nesting should be considered to alleviate any excessive loading on the inboard ship.

582-1.2.1 EFFECTIVENESS OF MOORING LINES. The overall mooring line pattern affects the load distribution to individual lines. The effectiveness of a mooring line is influenced by its slope (that is, the vertical angle formed by the line with the pier deck), and by the horizontal angle formed by the line with the centerline of the ship. The steeper the orientation of the line the less effective it is in resisting horizontal loads.

Some main guidelines for mooring line arrangements follow:

a. Mooring lines, including the bow and stern lines, should be arranged as symmetrically as possible about the perpendicular centerline of the ship (a line 90 degrees to the fore and aft centerline) to ensure a balanced load distribution among them.

b. Breast lines should be oriented perpendicular to the ship's fore and aft center line and as far aft and forward as possible.

c. Spring lines should be oriented as nearly parallel as possible to the longitudinal centerline of the ship.

d. The slope of the mooring lines should be kept as slight as possible.

e. Since the total stretch of a line is proportional to its length, the shorter lines will assume greater loads.

f. Do not mix lines of different materials and construction. For example, nylon, polyester, double-braided and three-Strand lines should not be used together, also synthetic mooring lines should not be used together with wire rope.

g. Normally, use only one mooring line per bitt and chock, more can be accommodated if necessary.

582-1.2.2 PREPARING MOORING LINES FOR USE. Mooring lines may be used in ship handing when leaving or coming alongside a ship or pier. Preparations for mooring must be made before the ship comes alongside the pier or wharf. Mooring lines should be faked out on deck near the chocks through which they will pass. The end of the mooring line with the eye is passed through the chock and the loop laid back on the lifelines, bulwarks or rails so they are ready for use. Mooring lines over five inches in circumference (hawsers), because of their weight, generally need short messengers attached to them so that the heaving line does not part during passing of the line. Use 1-1/2 inch circumference line, 12 to 18 feet in length as messengers. Messengers are normally made fast to the mooring line by splicing an eye into the eye of the mooring line. Some ships (e.g., ATS, ARS, T-AFT, etc) have no problem passing hawsers without using messengers because of their smaller lines, low freeboard, and short distance to be covered. Ships may exercise their own discretion, based on past experience, to use or not to use messengers to keep heaving lines from parting while passing mooring lines. If messengers are used, the guidance contained herein shall be used. Heaving lines, after they have been passed ashore, should

be made fast to the messenger or (for lines five inches and smaller) to the eye of the mooring line, but not at the end of the eye. This will prevent them from being caught between the eye and the bollard when the eye is placed over the bollard. Heaving lines should be passed to the line handlers on the pier or wharf as soon as possible. As the ship moves up the pier or into a slip, the pier ends of the mooring lines should be advanced up the pier so they are ready for use.

WARNING

Messenger lines are not designed to take a strain. If the end of a mooring line under tension enters the bitts or comes up to the capstan, personnel should not use the messenger to tend the mooring line. Personnel should clear the area.

582-1.2.3 DIPPING THE EYE. When two eyes are placed on the same bollard (Figure 582-1-2), the second eye should be lead up and through (dipped) the eye of the first before being placed over the bollard. With this arrangement, either eye can be taken from the bollard without removing the other. This is called dipping the eye.

582-1.3 EFFECT OF TIDE AND SHIP DISPLACEMENT ON MOORING LINES

582-1.3.1 VARIATION IN MOORING LINE LOADS. Mooring line loads are affected by changes in tide level and ship displacement (loaded vs. ballasted conditions). Variations in tide level and ship displacement can increase or decrease mooring line loads unless the lines are tended (heaved in or let out).

582-1.4 SUBMARINE MOORING

582-1.4.1 MOORING A SUBMARINE. A submarine can be secured to a pier, another ship such as a tender, or to another submarine. Mooring lines are used to secure the submarine to the pier or tender and restrain the submarine after it is in the desired position.

582-1.4.2 MOORING SYSTEM COMPONENTS ON A SUBMARINE. Retractable, portable or fixed cleats and chocks and a retractable hydraulically-operated capstan usually make up the mooring system on a submarine. (See Figure 582-1-3 for retractable cleats, Figure (TBD) for retractable chocks, and Figure 582-1-4 for retractable capstan) These components are used primarily for mooring the ship to the pier or tender. The cleats can be used in conjunction with the capstan to warp the ship into the berth. (See Figure 582-1-5 for submarine mooring arrangements) See the Ship System Manual (SSM) for recommended mooring arrangement of a specific submarine class for a specific mooring location.

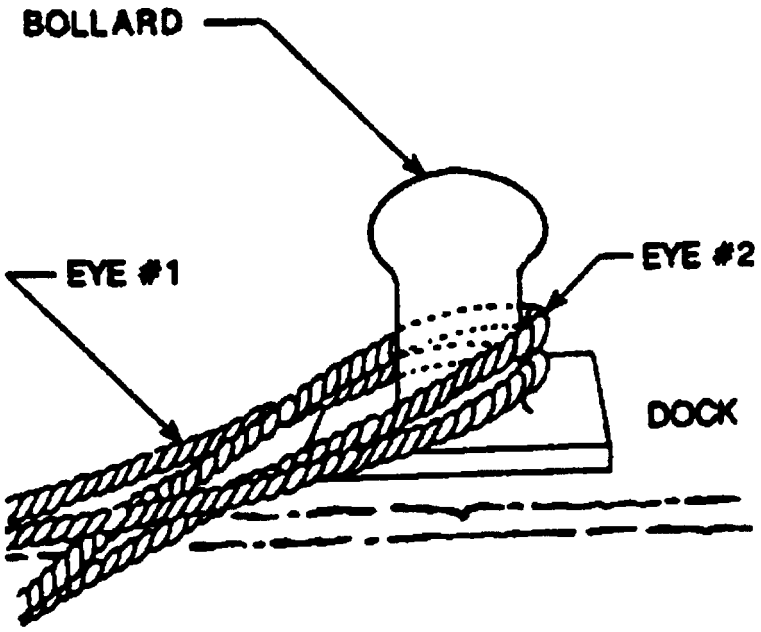


Figure 582-1-2 Bollard with Two Eyes

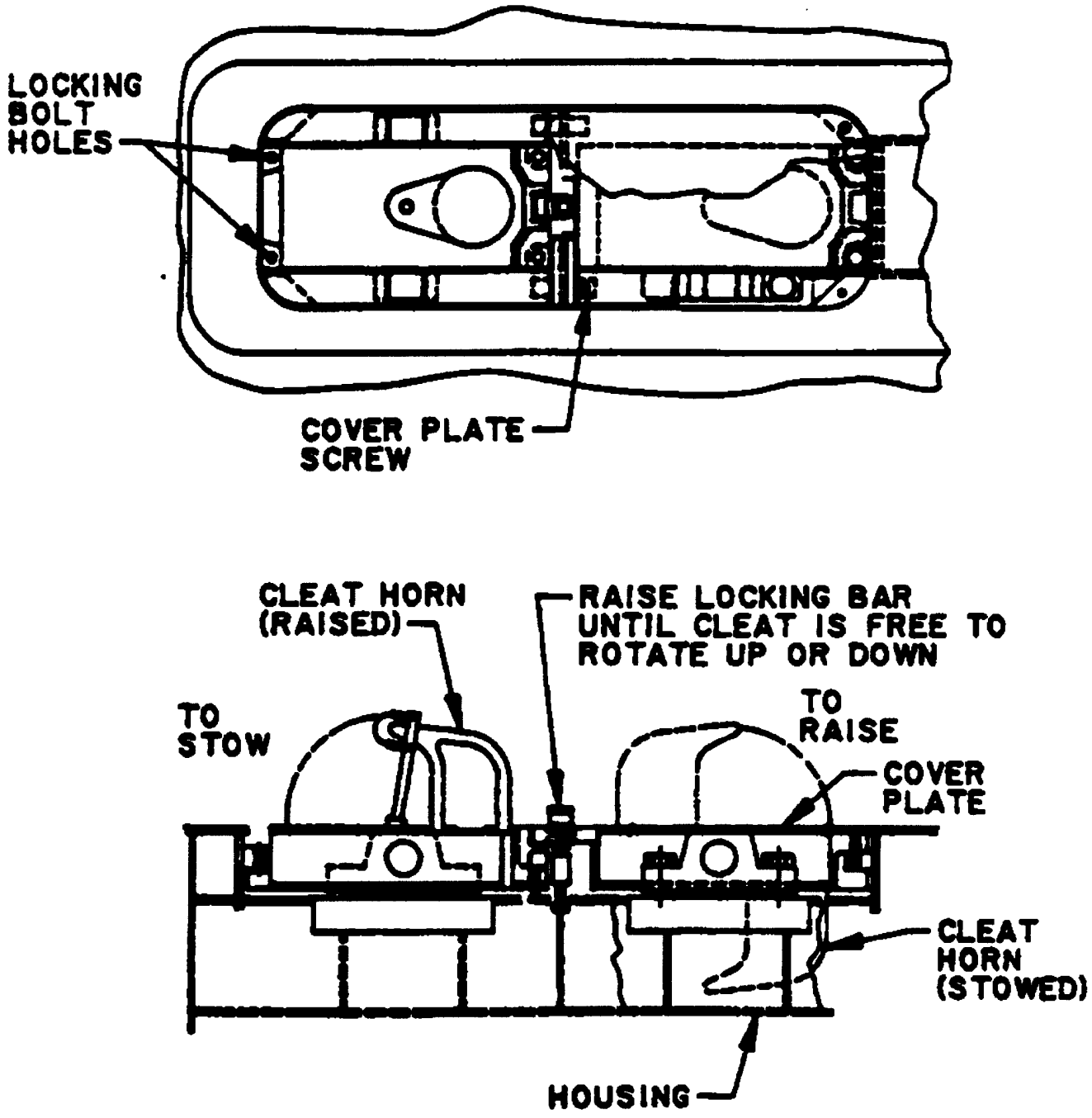


Figure 582-1-3 Retractable Cleat

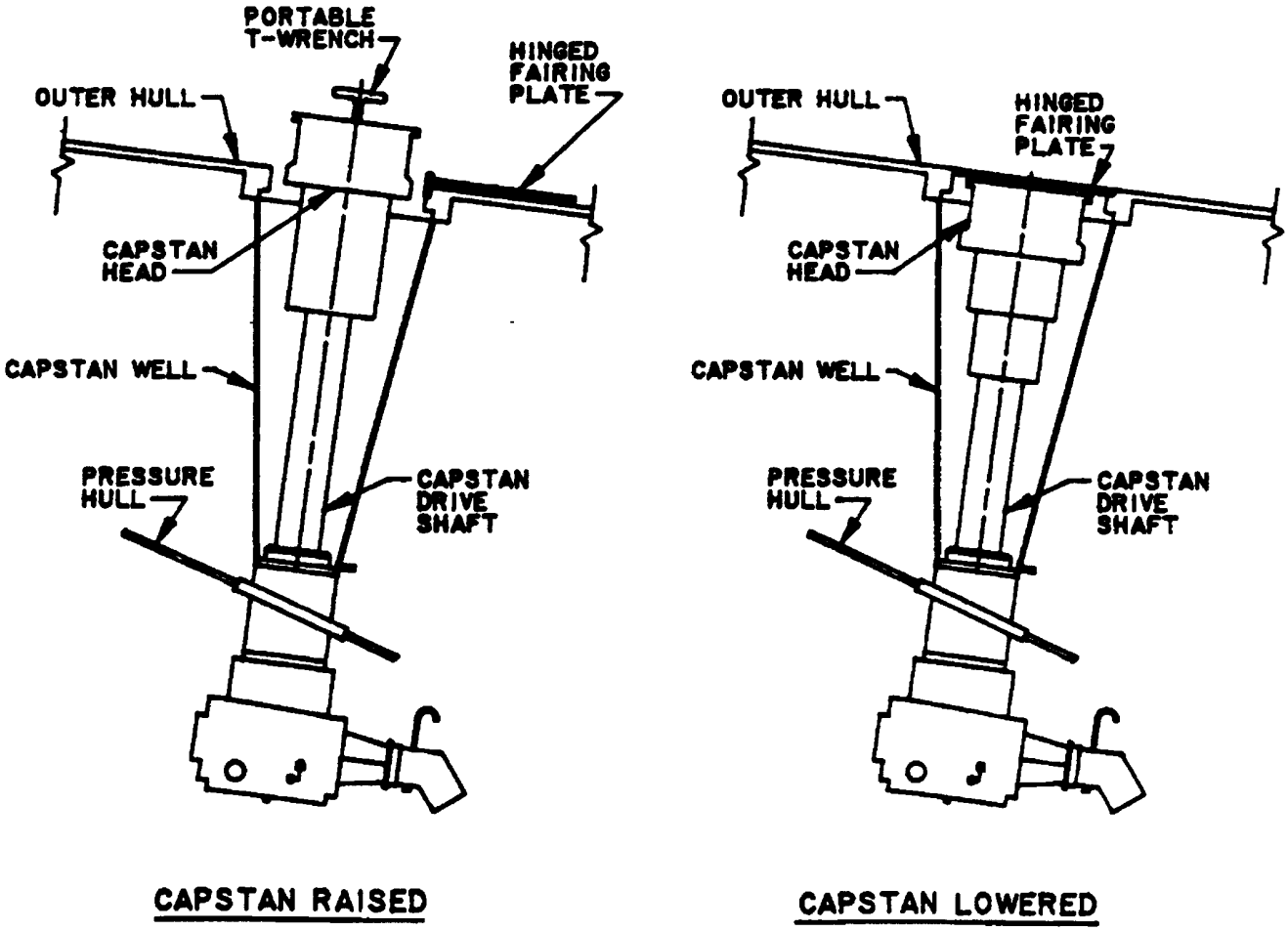
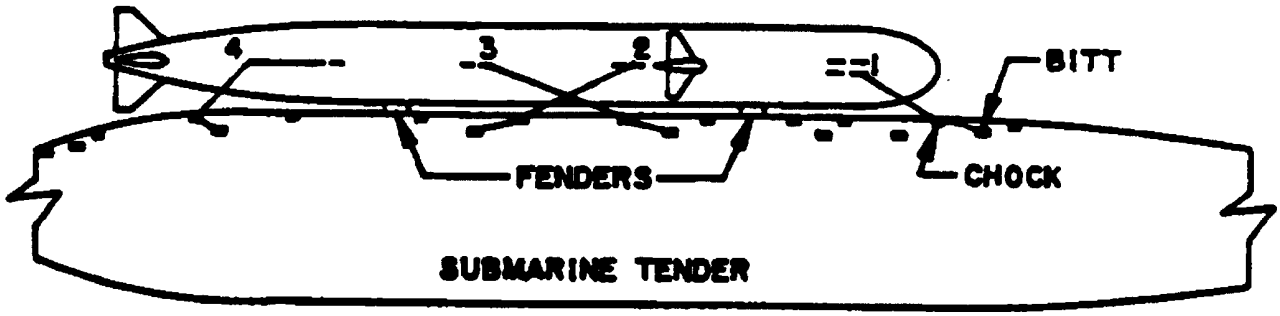
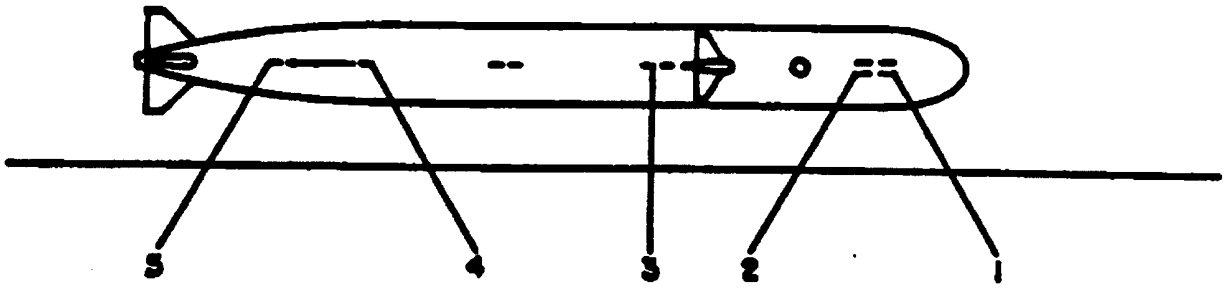


Figure 582-1-4 Retractable Capstan



LINE NO.	NAME		
1	BOW LINE	3	FORWARD WAIST SPRING
2	AFTER WAIST SPRING	4	STERN LINE

TYPICAL MOORING ARRANGEMENT WITH A TENDER



LINE NO.	NAME		
1	BOW LINE	4	FORWARD WAIST SPRING
2	AFTER WAIST SPRING	5	STERN LINE
3	WAIST BREAST		

Figure 582-1-5 Typical Submarine Mooring Arrangements

582-1.5 TECHNICAL AUTHORITY

582-1.5.1 SHORE-BASED MOORING GEAR. Mooring equipment, mounted or attached to piers or wharves, such as cleats, bollards, fenders, separators and camels, is under the technical responsibility of NAVFAC, Alexandria, VA. They have the responsibility for the administration, operation and procurement of mooring and docking gear not installed on or carried aboard the ship.

582-1.5.2 SHIP-BASED MOORING GEAR. Mooring equipment, permanently installed on or carried aboard ship, such as mooring winches, capstans, mooring lines, chocks, bitts, cleats, fenders and such, is the responsibility of NAVSEA life cycle management. Technical and maintenance support may be assigned to various technical authorities.

SECTION 2.
MOORING STRUCTURES AND SHIP APPROACHES FOR MOORING

582-2.1 PIERS, WHARVES AND DOCKS

582-2.1.1 MOORING OF NAVY SHIPS. When not underway, Navy ships can be moored to: piers or wharves, fixed structures that extend from the shore; mooring buoys that are attached to the seabed; another ship (nested).

582-2.1.2 DESCRIPTION OF DOCKS, PIERS, WHARVES AND SLIPS. Piers and wharves are often called docks and vice versa. These structures, which extend from the shore, are in water of sufficient depth for ships to approach and moor to them. A pier is usually oriented at right angles to the shore. A wharf is parallel to the shore. The space between adjacent piers is called a slip.

582-2.1.3 CONSTRUCTION OF WHARVES AND PIERS. Wharves and piers are sometimes built on piles which allows a free flow of water under them and in the slips in between. Their underwater construction may also be solid, in which case there will be no current inside the slips, but eddies may still be present. Buildings such as warehouses on the piers and wharves can vary the effect of the wind on the superstructure of a ship when it is approaching a pier or wharf.

582-2.1.4 EFFECTS OF WIND AND CURRENT WHEN MOORING. Observe the wind and current carefully when approaching the pier or wharf. Wind and current blowing and running at right angles to the pier or wharf usually present more of a problem than when they are moving parallel to the face of the pier or wharf. When possible use the wind and current to assist the mooring procedure.

582-2.1.5 MOORING PLAN. With a mooring plan the ship’s operator should be able to keep the ship under control as it approaches the dock. Make the plan before attempting the actual approach. The plan should consider the effects of wind and current on the ship’s momentum. The plan should have an approach course as well as points during the approach where speed will be reduced or engines stopped.

582-2.2 SINGLE-SCREW SHIP APPROACHING A PIER

582-2.2.1 PORTSIDE MOORING OF A SINGLE-SCREW SHIP. It is easy to dock a single-screw ship (right-handed propeller) when there is no current or wind acting on the ship. Head the ship for a point a short distance

outboard of the location where the bridge will be when the ship is moored. The approach course should be at an angle of 10 or 15 degrees with the pier wall. Use a slow approach speed and stop the propeller when the ship has sufficient headway to reach the berth. Maintain sufficient headway to steer when the ship is almost abreast of the berth. When the bow has been eased in alongside the berth, the propeller can then be backed to stop the ship and to swing the stern to port. When the ship is parallel to the pier, breast it in using the mooring lines and winches, if necessary.

582-2.2.2 STARBOARD SIDE LANDING OF A SINGLE-SCREW SHIP. When a single-screw ship moors starboard side to, the angle of approach should be about 10 degrees. Maintain minimum speed for proper steerage to minimize the ship's momentum. As the bow approaches the pier, put the rudder to port and, if necessary, use a short burst of power ahead to swing the bow away from the pier while the stern swings toward the pier. Use a short burst of power astern just before the ship is parallel to the pier. The sideways force from the propeller should ham the ship's swing so that it stops parallel with the pier abreast of the berth. The bridge should be at the initial point of approach when the ship is finished with this mooring evolution.

582-2.2.2.1 During the starboard side approach, the port anchor may be used to help with steering. For details of how to use the ship's anchor when mooring star board side to consult ″**Knight's Modern Seamanship** .″

582-2.3 LEAVING A PIER OR WHARF WITH NO WIND AND NO CURRENT

582-2.3.1 GETTING UNDERWAY. Departing a pier is usually less difficult than approaching it. First, carefully plan the departure after observing the wind and current. Then slack the mooring lines observing the effect of the wind and current. When the ship does not drift away from the pier, it is necessary to use power to move the stern away from the pier or wharf.

582-2.3.2 SINGLE-SCREW SHIP MOORED STARBOARD SIDE TO AND GETTING UNDERWAY. When the engine is backed for a single screw ship with the starboard side to the pier, the stern swings to port and the ship starts moving aft. With the bow turned toward the pier, the rudder is put over to the right to clear the pier as the ship goes astern. When the stern is about 50 feet out, the bow will be pointed toward the pier. A quarter breast mooring line can now be used as a spring line as the ship continues going slowly astern. When this line is held the bow comes away from the pier. When clear of the pier or wharf and able to proceed ahead, the ship casts off lines and goes ahead.

582-2.3.3 SINGLE-SCREW SHIP MOORED PORT SIDE TO AND GETTING UNDERWAY. When the ship is moored port side to the pier and preparing to depart, an after bow spring line is used to hold the ship as it goes ahead slowly and the bow springs in. Left rudder is used to help get the stern clear of the pier. The ship's lines are then cast off. The ship is then backed down slowly with right full rudder until clear of the pier. As the stern gradually turns toward the pier, the engines are stopped when the ship is parallel to the pier and several beams' width from it. The ship then proceeds ahead with sufficient right rudder to bring the bow to the required departure course.

582-2.3.4 TWIN- OR MULTIPLE-SCREW SHIP GETTING UNDERWAY. A twin- or multiple screw ship can easily depart a pier by holding the after bow spring line and slacking off all other lines. The outboard engine is put slow ahead until the inboard propeller is clear of the pier. Fenders should be used as necessary on the bow. Once the inboard propeller is clear, all lines are let go and both engines backed slow. The discharge current from the inboard propeller will help breast the ship out. The conning officer should look aft to note any tendency of the ship to start swinging either way. The engines should be used for steering until sufficient sternway is reached

and the rudders can be used. The distance between the pier and the bow should be noted and the rate of turn controlled to prevent touching the pier. The discharge current from the inboard screw tends to keep the bow off the pier.

582-2.4 COMING ALONGSIDE AND CLEARING A BERTH

582-2.4.1 GENERAL. The situations covered in paragraphs 582-2.2 and 582-2.3 are only two of the many situations that are encountered when a ship is maneuvering up to or leaving a pier, wharf, mooring buoy or another ship. Three sources that can be consulted for information on ship mooring procedures are:

- Naval Shiphandling
  - Knight's Modern Seamanship
  - Boatswain's Mate 1 and C.

582-2.4.2 TUGS AND THRUSTERS. To assist in the docking of a ship, tugs and the ship's thrusters can be used. Thrusters are installed in some ships to improve their maneuvering capabilities at low or zero speeds. Depending on the type of thruster and its location in the ship's hull, it can be used to help maneuver the ship when docking. Essentially tugs either push or pull. Obviously their capability can assist the ship's operator when docking a ship. **Naval Shiphandling** or **Knight's Modern Seamanship** can be consulted for more information on tugs and their use in mooring operations.

582-2.5 ORDERS TO THE SHIP'S LINE HANDLERS

582-2.5.1 COMMANDS FOR THE SHIP'S LINE HANDLERS. The following commands in Table 582-2-1 are used to communicate with the ship's line handlers during mooring evolutions:

Table 582-2-1 LINE HANDLER COMMANDS

Command	Meaning
Pass one (or number one)	Send line number one over to the pier. Place the eye over the bollard or cleat, but do not take a strain.
Slack (slack off) the bow line (number one)	Pay out the line specified, allowing it to form an easy bight.
Take a strain on one (or number one)	Put number one line under tension.
Take in the slack on three (or number three)	Heave in on number three line, but do not take a strain.
Ease three	Pay out number three line enough to remove most of the tension.
Avast heaving	Stop heaving (taking in).
Check three	Hold number three line, but not to the breaking point, let the line slip as necessary.
Hold two	Take enough turns so that number two line will not slip.
Double up and secure	Run additional lines, or bights of lines, as needed, to make the mooring secure.
Single up	Take in all lines except a single standing part to each station, preparatory to getting under way.
Stand by your lines	Man the lines, ready to cast off or moor.

Table 582-2-1 LINE HANDLER COMMANDS - Continued

Command	Meaning
Take in one (or number one)	Retrieve line number one after it has been cast off. When used by the conning officer, it means to slack one, cast it off and then pull it back aboard. When used by the officer in charge on the forecastle, it is preceded by the commands slack one and cast off one and means merely to retrieve line number one and bring it back on deck.
Up behind	Cease hauling on the line and slack it quickly.
Cast off	A command to those tending the mooring lines on the pier or on another ship to disengage or throw off the lines from over the bollards or cleats.

582-2.6 MOORING CONFIGURATIONS

582-2.6.1 GENERAL. Mooring parallel to a pier or wharf is the most common mooring configuration for Navy ships. Paragraphs 582-2.6.1.1 through 582-2.6.1.6 describe alternative configurations used to moor Navy ships.

582-2.6.1.1 Free-Swinging Moorings. A ship moored to a free-swinging (single-point) mooring is restrained by its anchor chain attached to the mooring buoy. The ship is free to swing or **weather-vane** around the mooring buoy (Figure 582-2-1). A free-swinging mooring is generally more economical than a multiple point mooring, but requires ample anchorage area to prevent the ship from interfering with navigation, adjacent structures or neighboring ships.

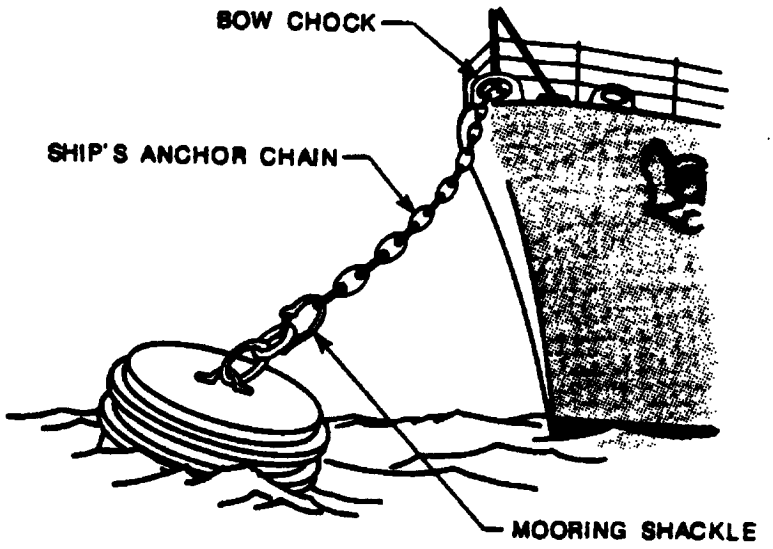


Figure 582-2-1 Free-swinging (Single-point Mooring)

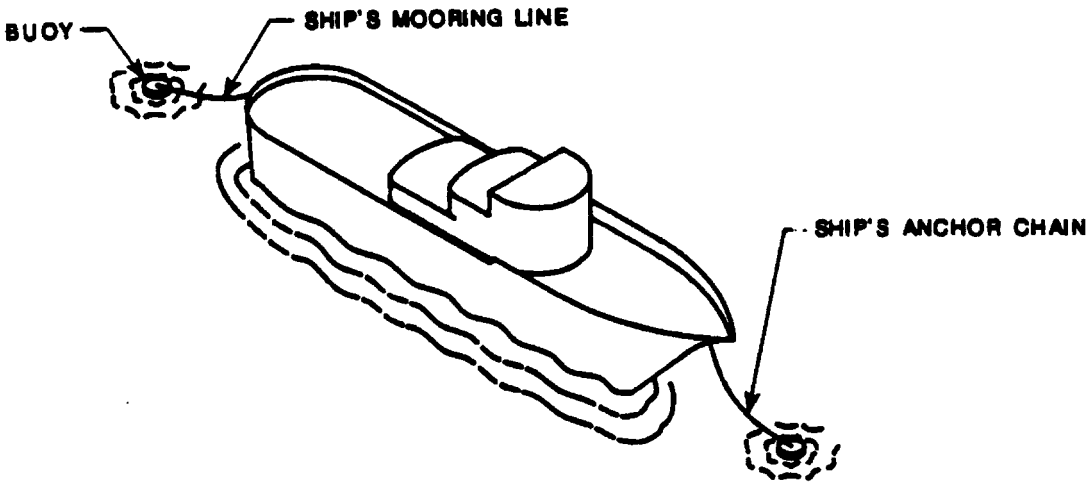


Figure 582-2-2 Bow-and-stern Mooring

582-2.6.1.2 Multiple-point Moorings. Several types of multiple-point moorings are used by the Navy. Selection of a specific type of multiple-point mooring depends upon site conditions, existing facilities and mooring use. Some of the more common types of multiple-point moorings are discussed in paragraphs 582-2.6.1.3 through 582-2.6.1.4.

582-2.6.1.3 Bow-and-Stern Moorings. A bow-and-stern mooring consists of a ship secured at its bow and stern to mooring buoys. The system is generally used when there is insufficient area for a free-swinging mooring such as in small or congested harbors. To tie up to the mooring buoys, most ships use their anchor chain forward and a mooring line or wire rope aft. A typical bow-and-stern mooring arrangement is shown in Figure 582-2-2.

582-2.6.1.4 Four-point Moorings. A four-point mooring consists of a ship secured at four points to mooring buoys. A typical four-point mooring arrangement is shown in Figure 582-2-3. The four-point mooring concept can be extended to more than four points; that, is, to six points, eight points, and so on.

582-2.6.1.5 Mediterranean-type (Med-type) Moorings. In a Med-type mooring, the stern of the ship is secured to a fixed structure with mooring lines. The bow of the ship can be secured to mooring buoys or by its own anchors. Some typical Med-type mooring arrangements are shown in Figure 582-2-4. Med-type moorings are used where there is insufficient harbor area for a free-swinging mooring or for a different type of multiple-point mooring, such as in the Mediterranean Sea. Med-type moorings are particularly well-suited for submarine and destroyer tenders.

582-2.6.1.6 Nested-ship Moorings. A multiple-ship (nested) mooring consists of ships moored side by side, using the regular mooring lines. These moorings are normally bow-and-stern. Multiple-ship moorings are used to moor both active and inactive ships. A typical active multiple-ship mooring consists of a tender or similar ship with submarine(s) secured to either one or both sides, as shown in Figure 582-2-5. Multiple-ship moorings for inactive ships often consist of several identical ships in a bow-and-stern mooring.

582-2.6.2 SPUD MOORING. A spud is a steel member, usually an H-beam, a piling or a built-up section. Moorings using spuds are called spud moorings. Spud moorings are often used to moor floating drydocks, as

shown in Figure 582-2-6. Spuds can also be pilings driven into the bottom, either temporarily or permanently. The ship in this case is normally connected to the spud with a large ring or collar that is free to move vertically as the tide rises and falls.

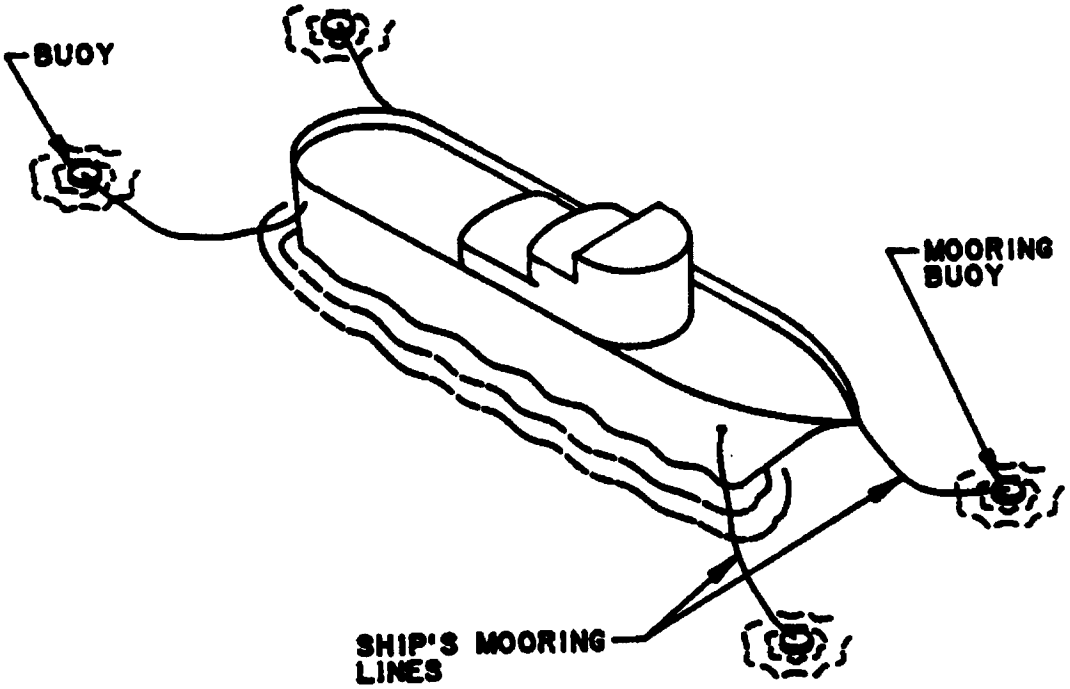


Figure 582-2-3 Four-point Mooring

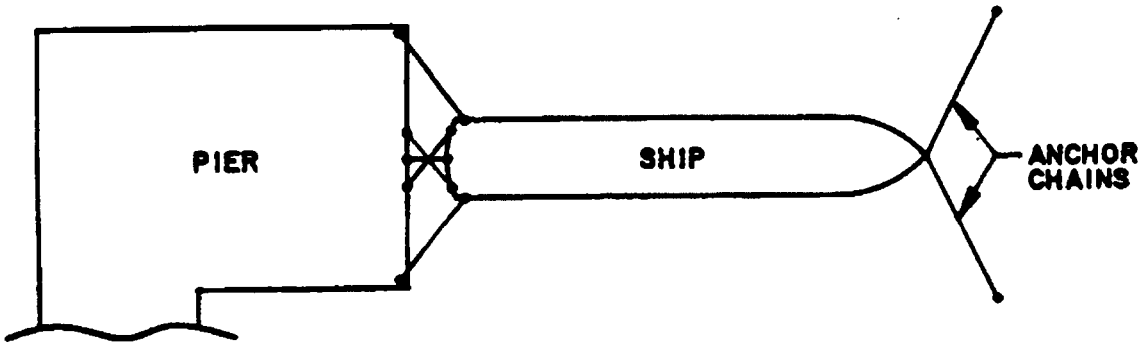
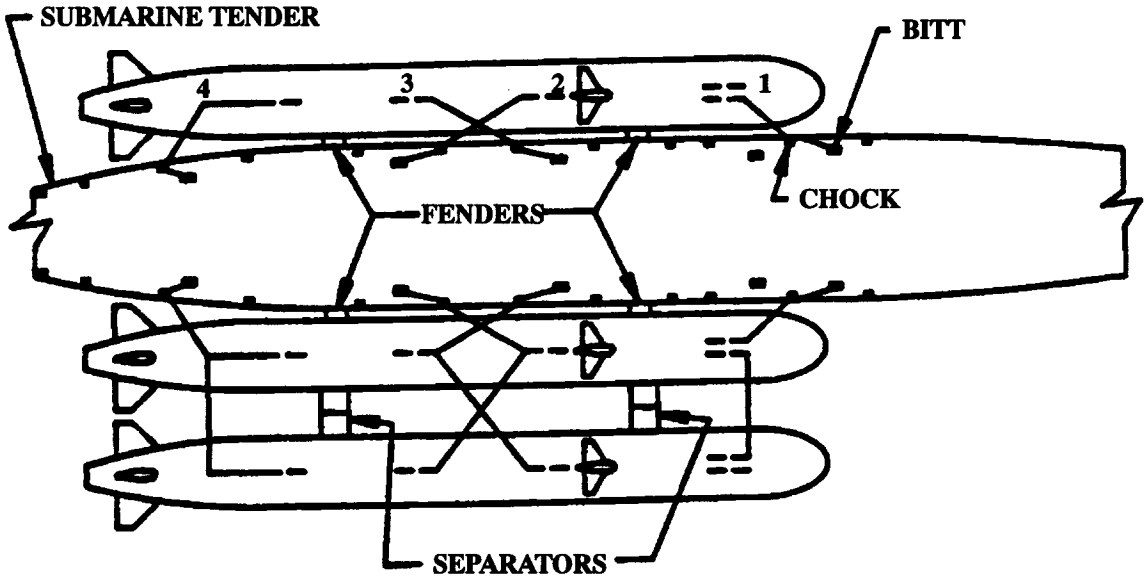


Figure 582-2-4 Med-type Mooring



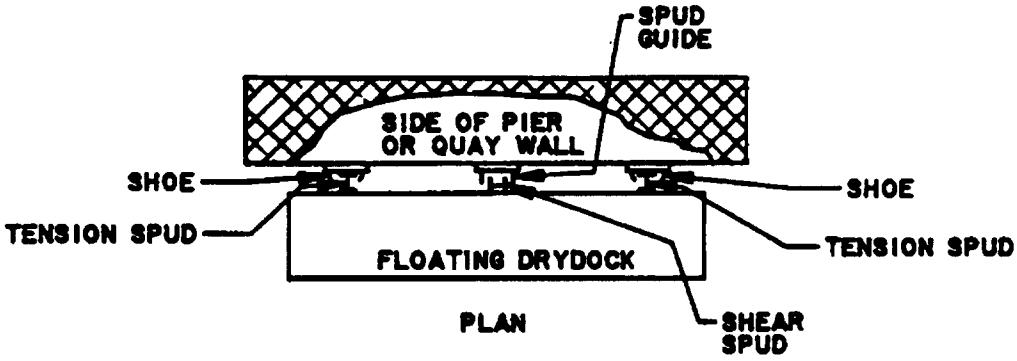
LINE NO.	NAME		
1	BOW LINE	3	FORWARD WAIST SPRING
2	AFTER WAIST SPRING	4	STERN LINE

Figure 582-2-5 Nested-ship Mooring

582-2.7 TYPICAL MOORING ARRANGEMENTS FOR THE MAJOR SHIP CLASSES

582-2.7.1 NAVY SHIP MOORING ARRANGEMENTS. Figure 582-2-7, Figure 582-2-8 and,Figure 582-2-9 show some typical mooring arrangements used by Navy ships. Each ship carries a mooring drawing which shows the mooring equipment for that ship. This drawing shows how the mooring lines can be lead for pierside mooring and other mooring situations. Consult the drawing for the proper way to moor a particular ship. Another source of information is the Ship Information Book (SIB) which usually has a mooring line diagram showing how to moor the ship for various situations. Figure 582-2-10 shows arrangements used for heavy weather conditions in comparison to arrangements used for normal weather conditions. Figure 582-2-11 shows the arrangement of synthetic mooring lines that have been doubled-up for use under conditions such as heavy weather.

582-2.7.2 MOORING TO AN ICE SHELF. When operating in arctic or antarctic regions, ships must sometimes moor to ice formations. The mooring lines are secured to these ice formations using timbers (called deadmen) buried in the ice. Figure 582-2-12 shows a ship moored in ice using deadmen. This type of arrangement is convenient because the deadmen can be left in the ice when the ship departs. Icebreakers can moor to the edge of an ice shelf by ramming the ship into the ice until the hull contacts the ice from the bow to amidships. Ice anchors or the ship’s regular anchors can then be deployed to keep the ship from sliding back off the ice shelf. The anchors can be set into holes chipped out of the ice.



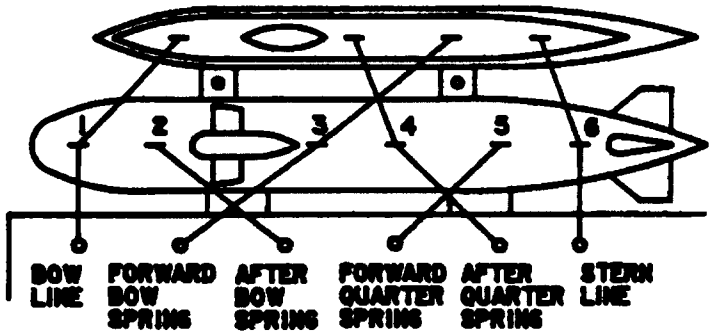


Figure 582-2-6 Spud Mooring

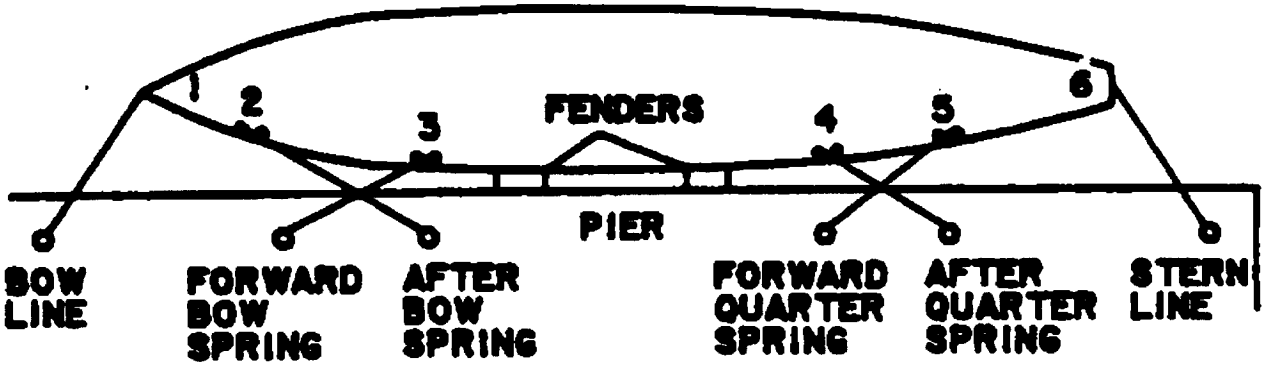
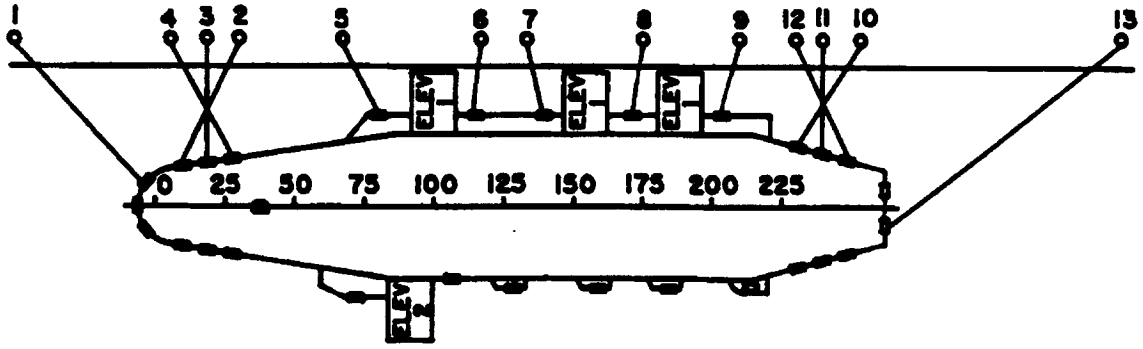
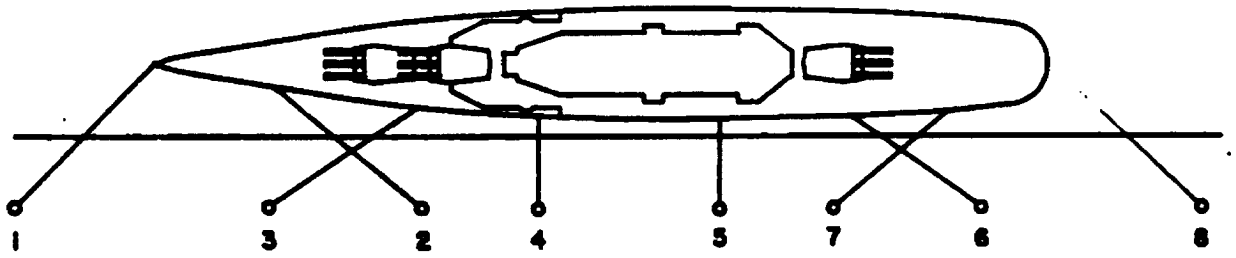


Figure 582-2-7 Mooring Lines for a Destroyer



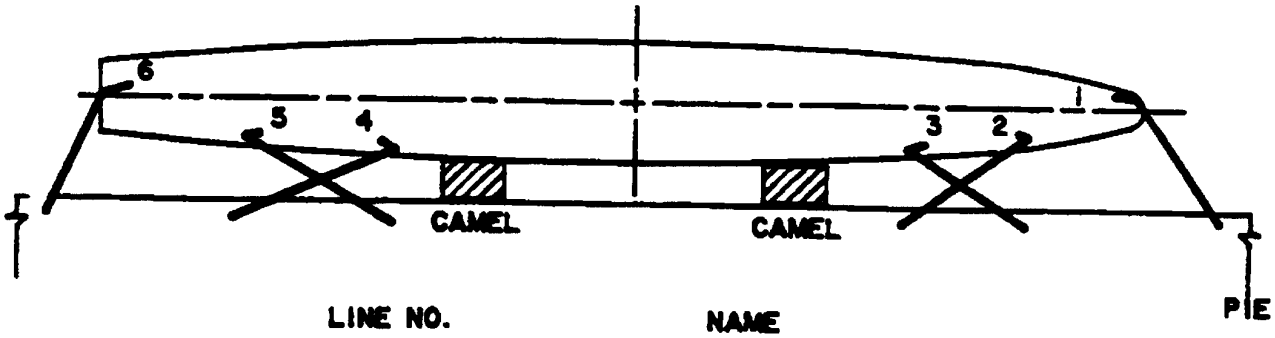
LINE NO	NAME		
1	BOW LINE	8	WAIST BREST
2	AFTER BOW SPRING	9	AFTER WAIST SPRING
3	BOW BREAST	10	AFTER QUARTER SPRING
4	FORWARD BOW SPRING	11	QUARTER BREST
5	FORWARD WAIST SPRING	12	FORWARD QUARTER SPRING
6	AFTER WAIST SPRING	13	STERN LINE
7	FORWARD WAIST SPRING		

Figure 582-2-8 Mooring Lines for a Large Carrier



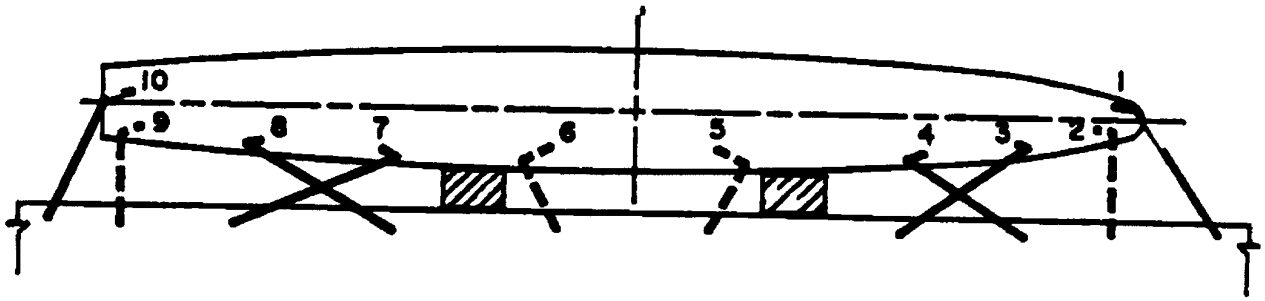
LINE NO	NAME		
1	BOW LINE	5	AFTER WAIST BREAST LINE
2	AFTER BOW SPRING LINE	6	AFTER QUARTER SPRING LINE
3	FORWARD BOW SPRING LINE	7	FORWARD QUARTER SPRING LINE
4	FORWARD WAIST BREAST LINE	8	STERN LINE

Figure 582-2-9 Mooring Lines for a Battleship



LINE NO.	NAME
1	BOW LINE
2	AFTER BOW SPRING
3	FORWARD BOW SPRING
4	AFTER QUARTER SPRING
5	FORWARD QUARTER SPRING
6	STERN LINE

MOORING LINE ARRANGEMENT USED FOR NORMAL WEATHER CONDITION



LINE NO.	NAME
1	BOW LINE
2	BOW BREAST LINE
3	AFTER BOW SPRING
4	FORWARD BOW SPRING
5	FORWARD WAIST BREAST
6	AFTER WAIST BREAST
7	AFTER QUARTER SPRING
8	FORWARD QUARTER SPRING
9	STERN BREAST LINE
10	STERN LINE

MOORING LINE ARRANGEMENT USED FOR HEAVY WEATHER CONDITION
ADDITIONAL MOORING LINES IN PLACE

Figure 582-2-10 Mooring Lines for Normal and Heavy Weather Conditions

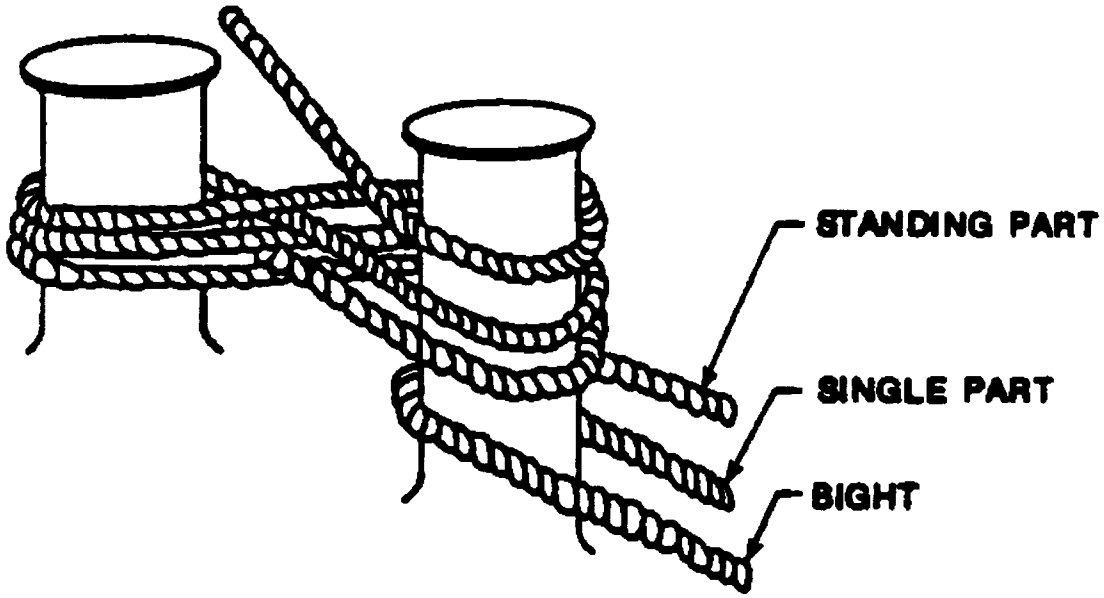


Figure 582-2-11 Correct Method for Doubling-up

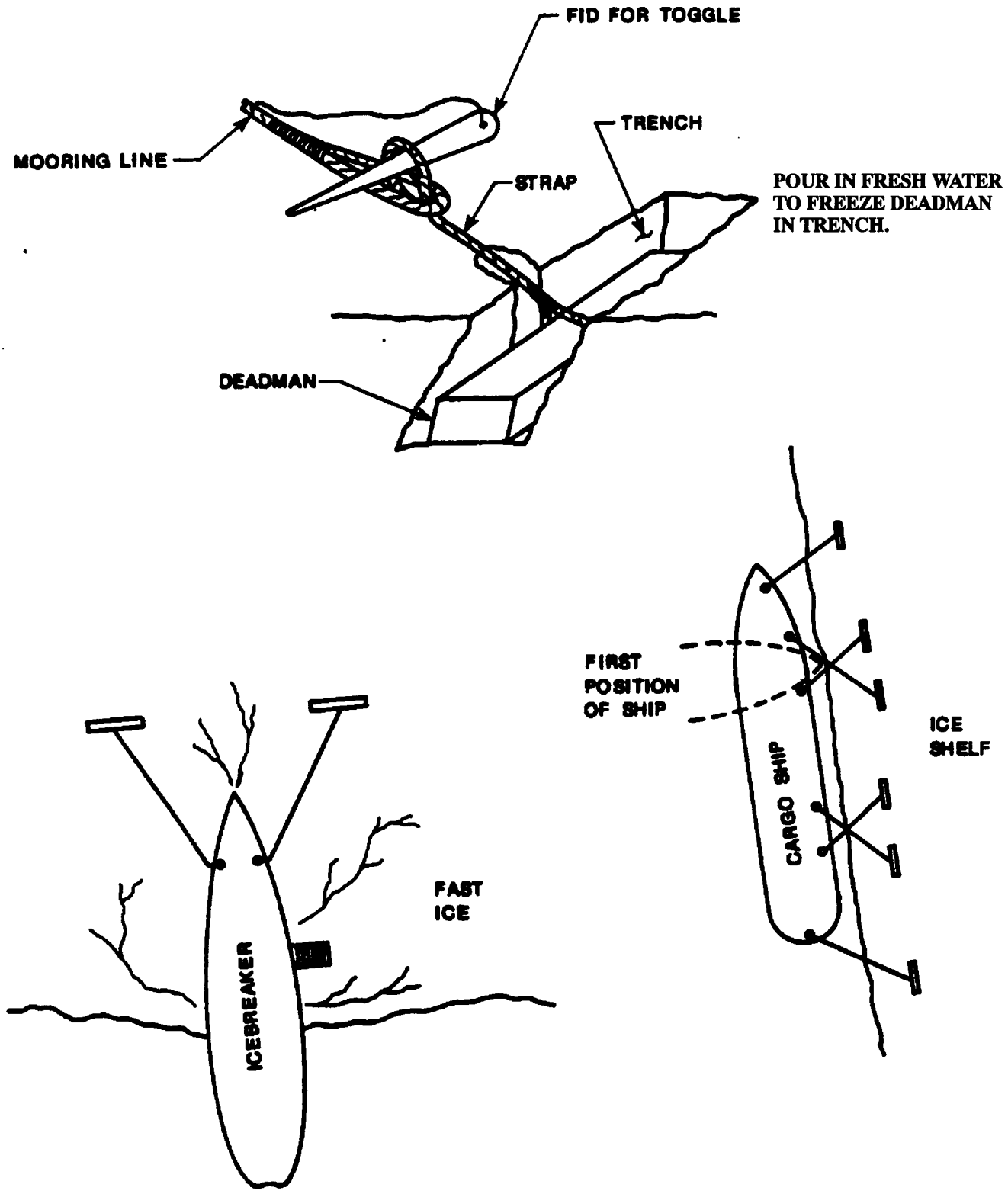


Figure 582-2-12 Using Deadmen to Moor to the Ice Shelf

SECTION 3.

MOORING LINES AND EQUIPMENT

582-3.1 MOORING EQUIPMENT

582-3.1.1 GENERAL. The size of the mooring equipment used is primarily a function of the size, breaking strength and length of the mooring lines used. The larger the ship, the larger and stronger the mooring lines and equipment. Synthetic fiber rope, 6-1/2 inches or greater in circumference, should be handled by capstans or warping winches. Figure 582-3-1 and Figure 582-3-2 show typical layouts of mooring equipment used on Navy surface ships.

582-3.1.2 MOORING LINES. The mooring lines provided are of adequate strength, easy to handle and long enough to double up. Synthetic ropes, especially those made of polyester, nylon and aramid, are used extensively for mooring and warping operations. Table 582-3-1 lists the type of mil-spec rope commonly used for mooring lines. **NSTM Chapter 613, Wire and Fiber Rope and Rigging** , can also be consulted for details on the various types of mil-spec ropes. Synthetic ropes are manufactured using the following principal types of construction:

582-3.1.2.1 Three-strand or twisted rope. This rope consists of three strands, twisted together. It is suitable for mooring and warping applications.

582-3.1.2.2 Plaited rope. Composed of eight rope strands. Plaited rope is nonrotating and is widely used in mooring and towing applications. It does not require special handling procedures.

582-3.1.2.3 Double-braided rope. This line has one hollow braided rope within another. This construction is also nonrotating and is used for mooring and towing applications.

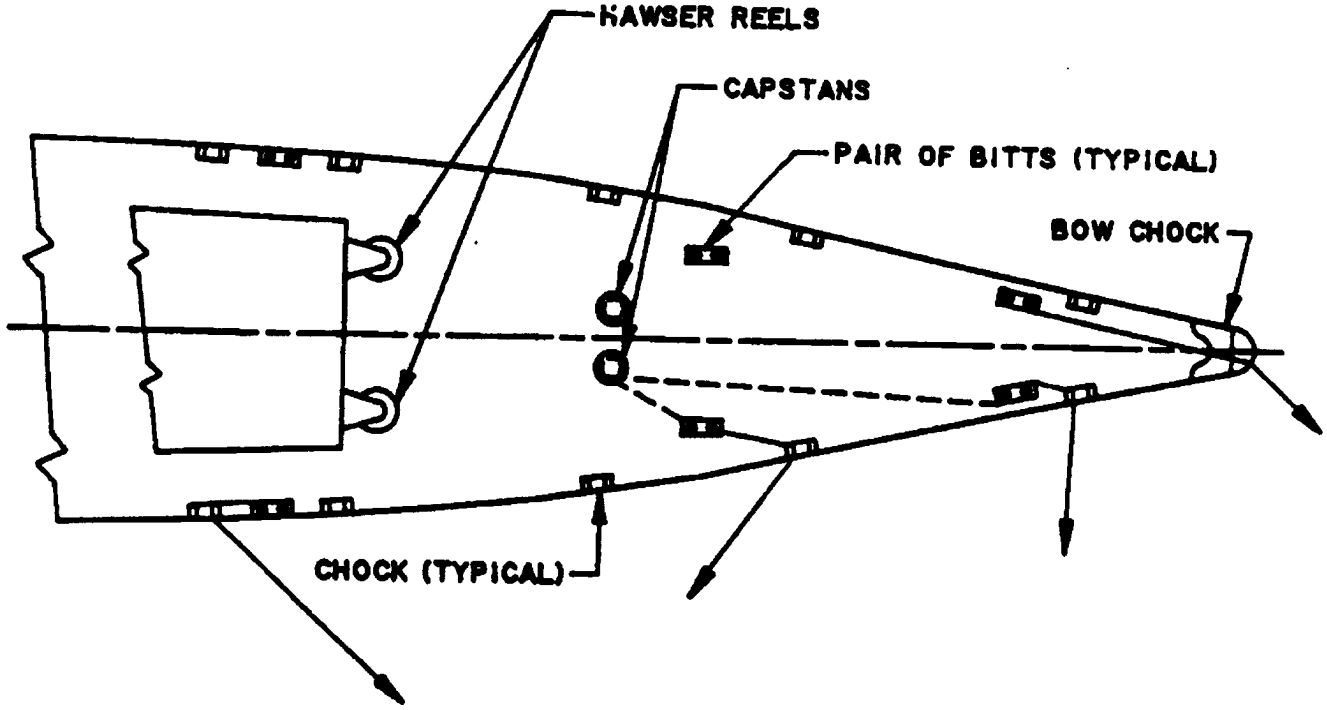


Figure 582-3-1 Typical Mooring Arrangement on Ship's Forecastle

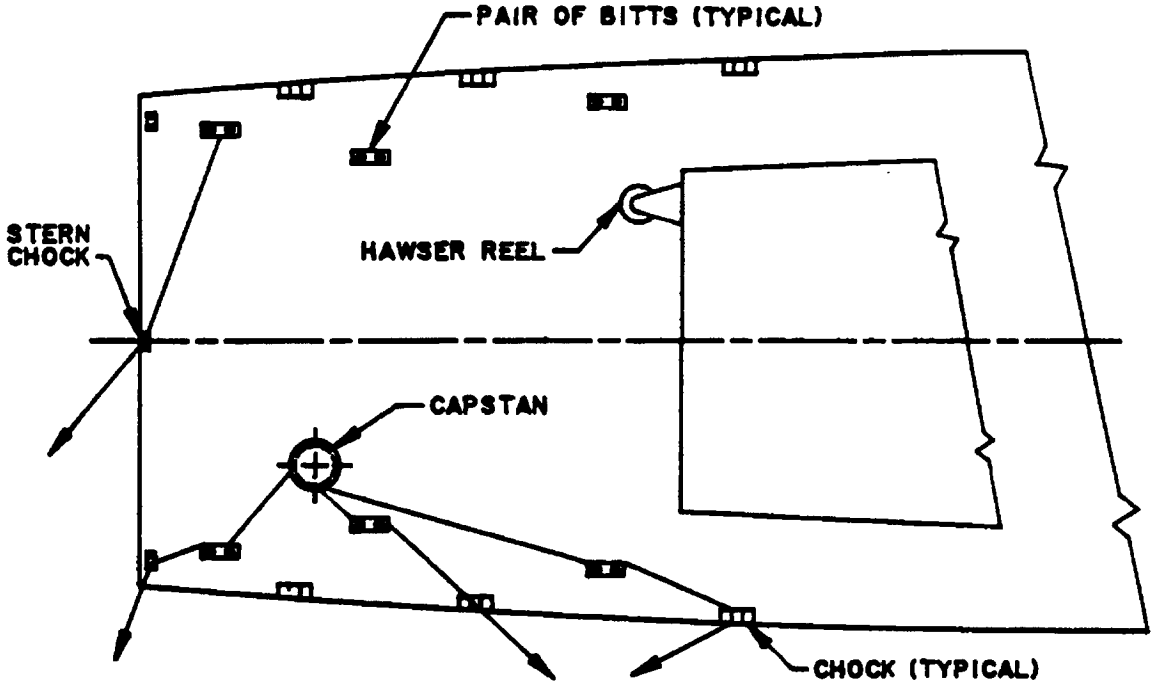


Figure 582-3-2 Typical Mooring Arrangement on Ship's Quarter

582-3.1.2.4 Four-strand rope. A four-strand rope of aramid fibers made similar to wire rope. It can be used for

pierside mooring and tending lines. Stowage and handling are similar to three-strand construction rope. This rope shall be spliced in accordance with **NSTM Chapter 613, Wire and Fiber Rope and Rigging** , for plain laid rope except that the tucks should go with the lay of the strands.

582-3.1.2.5 Synthetic Mooring Line Materials. The synthetic fibers currently in use for making synthetic mooring lines are nylon, polyester and aramid. Nylon and polyester ropes are the types most commonly used. However, the new four-strand aramid lines are now replacing other synthetic lines.

582-3.1.2.6 Mooring Line Abrasion. When rope is first put in service, many and various abrasive surfaces will cause the outer filaments of the rope to form a fuzzy surface appearance and texture. This is the result of those filaments breaking. This **roughened** surface, however, actually forms a protective cushion and shield for the fibers underneath. This, in turn, tends to help retard further abrasion and damage to the sub-surface fibers. This condition should stabilize, not progress. If surface roughness increases, excessive abrasion is taking place and strength is being lost.

582-3.1.2.7 Mooring Line Procurement. Consult the ship's Coordinated Shipboard Allowance List (COSAL) when ordering new or replacement mooring lines. Mooring lines are listed under NSN-4020, Federal stock class number.

582-3.1.3 TATTLETALE. To determine when the tension in a synthetic hawser is approaching the danger point, a tattletale (optional) may be used. This is a piece of 6-thread manila rope of predetermined length secured to the hawser at two points, a specified distance apart. The tattletale is secured at the two points, with the synthetic hawser straight but under no tension. As the hawser stretches under load, the distance between the attachment points on the hawser increases. When the tattletale becomes taut the critical load on the hawser has been reached and it is in danger of breaking. DO NOT use a tattletale with natural fiber or wire ropes. Since four-strand aramid fiber rope stretches only six percent at minimum breaking strength, tattletale cords cannot be used to determine the strain on the mooring line.

582-3.1.3.1 Tattletale Dimensions. Figure 582-3-3 shows a tattletale attached to a line when slack and then when stretched. Table 582-3-2 lists the dimensions of tattletales for the different types of lines and construction. The dimensions are different for lines of the same material but of different construction.

582-3.1.4 MOORING CHOCKS.

582-3.1.4.1 Chocks. Closed chocks are generally welded to the edge of the deck for fair-leading mooring lines. On ships with bulwarks, the chocks consist of heavy rings welded into the bulwark. The riding surface of chocks should be maintained smooth with a roughness of 125 micro inches or less (surface roughness is defined in ANSI B46.1). Chocks are located so that lines leading through them to capstans or winches will not chafe on sharp edges or equipment. If this occurs, chafing plates or pipes should be installed. Figure 582-3-4 shows the Navy standard closed mooring chock used on a surface ship. NAVSEA Dwg No. 804-1843363, **Chocks for Synthetic Rope** , has dimension size and strength data for Navy chocks. NAVSEA Dwg No. S1201-921623 shows details of a 16-inch, two-roller chock. Some chocks are retractable (see Figure [TBD] for submarines and Figure [TBD] for surface ships).

Table 582-3-1 FIBER ROPE SPECIFICATIONS

Type of Rope	Circumference (inches)	Specifications
Nylon three-strand	Up to 12	MIL-R-17343
Nylon plaited	Up to 16	MIL-R-24337
Nylon double-braid	Up to 16	MIL-R-24050
Polyester three-strand	Up to 12	MIL-R-30500
Polyester double-braid	Up to 16	MIL-R-24677
Polyester plaited	Up to 16	MIL-R-24730
Four-strand aramid	Up to 8-3/16	CID* A-A-50435

*CID = Commercial Item Description

582-3.1.4.2 Panama Canal Chocks. For transiting the Panama Canal, non warships are fitted with chocks designed in accordance with the Panama Canal regulations. The requirements for **Panama Canal chocks** (Figure 582-3-5) are found in Title 35 of the Code of Federal Regulations (CFR). The size 20 chock, as shown on NAVSEA Dwg No. 804-1843363, is designated as a **Panama Canal chock** .

582-3.1.4.3 Roller Chocks. When warping into a pier, roller chocks (Figure 582-3-6) are sometimes provided to reduce wear on the mooring lines. Roller chocks must be lubricated quarterly or they freeze up.

582-3.1.5 BITTS. Bitts are made of vertical cylinders, called barrels, usually arranged in pairs, which are used for making fast mooring lines. The bitt barrel is fitted with a top plate and rope guard to keep lines from slipping off accidentally. Since bitts are required to take very heavy loads, extra frames are added to their foundations to distribute the strain. Usually there is a set of bitts forward and abaft of each chock. Bitts can be retractable (Figure 582-3-7), fixed (Figure 582-3-8) or recessed shell type (Figure 582-3-9). Recessed shell bitts are designed for use with 3-inch circumference 3-strand nylon line. Details, sizes and strengths of bitts for synthetic rope are shown on NAVSEA Dwg No. 804-1843362. Similar information for recessed shell bitts is found on NAVSEA Dwg. No 805-1841948.

582-3.1.6 BOLLARDS. A bollard is a strong, cylindrical upright fitting found on a pier or wharf around which the eye of a ship’s mooring line is placed (Figure 582-3-10). Bollards are the technical responsibility of NAVFAC.

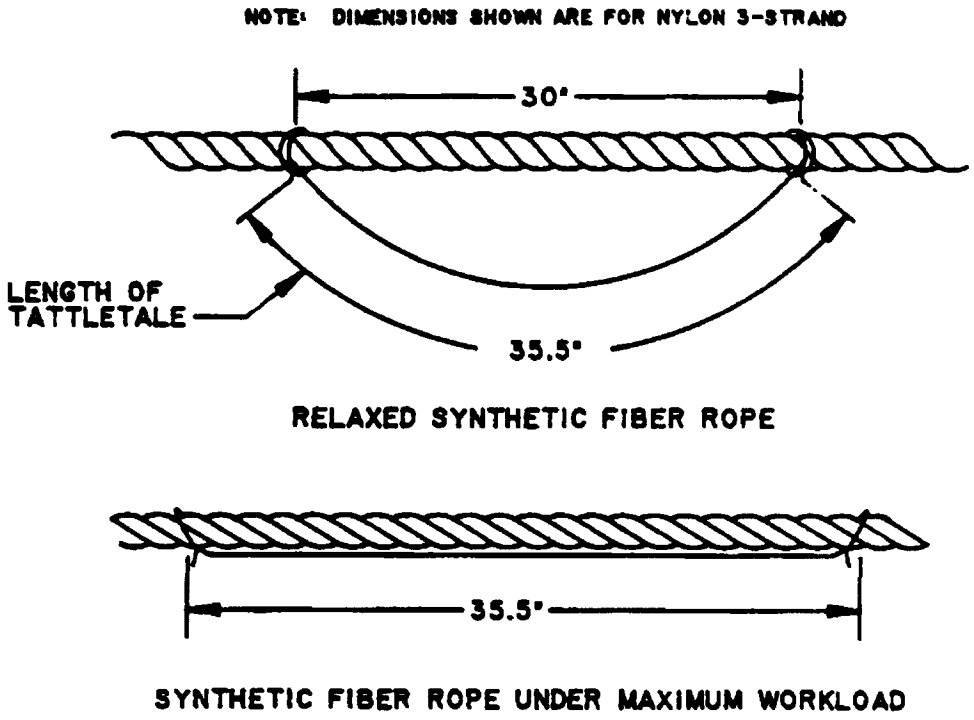


Figure 582-3-3 Tattletale

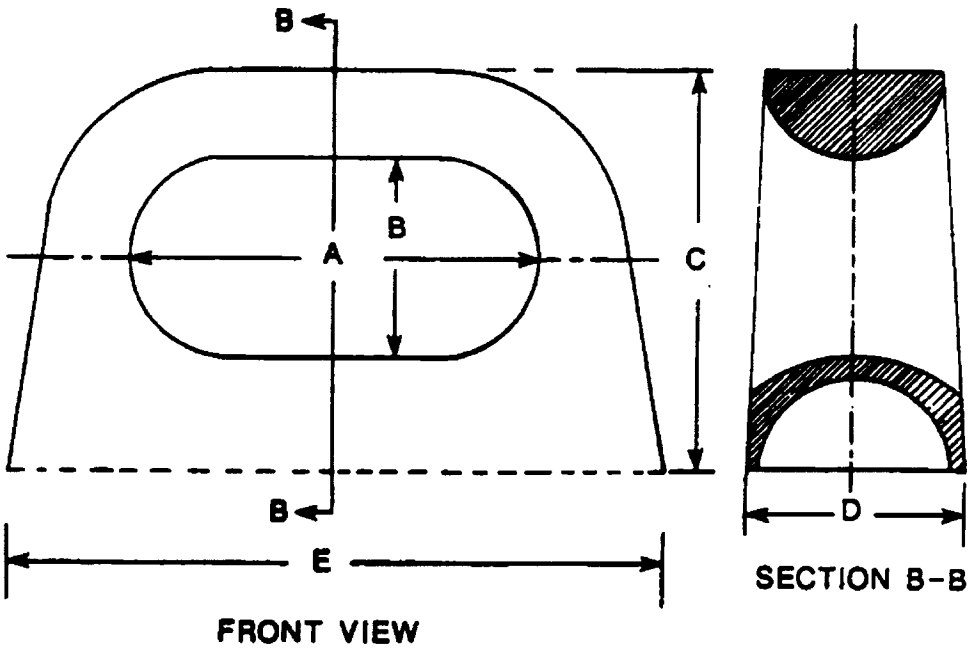
Table 582-3-2 DIMENSIONS FOR TATTLETALE LINES

Type of Synthetic Rope	Length of Tattletale (inches)	Distance Between Marks (inches)
Nylon three-strand	35-1/2	30
Nylon plaited	43-1/2	40
Nylon double-braid	43-1/2	40
Polyester three-strand	63-1/2	60
Polyester plaited	62-1/2	60
Polyester double-braid	62	60
Note: Length of tattletale is arc length only (see Figure 582-3-3). Add extra rope length, as required, to tie to main line.		

582-3.1.7 HAWSER REELS. Vertical and horizontal hawser reels for storing mooring lines and towing hawsers are provided according to rope size and rope length. Hawser reels are designated as vertical or horizontal according to the orientation of their reel shafts shown in Figure 582-3-11. Details on the size and construction of vertical hawser reels are found on NAVSEA Dwg No. S2604-921842. Details on the size and construction of horizontal reels are found on NAVSEA Dwg No. S2604-921841.

582-3.1.8 FAIRLEADERS. Fairleaders are used to lead mooring lines around obstructions and provide proper alignment with winches or capstans. Fairleaders (Figure 582-3-12) are located so as to accommodate lines from both sides of the ship. Fairleaders usually have rollers to reduce line wear.

582-3.1.9 CLEATS. Cleats are twin horned-shaped devices used for securing lines. Figure 582-3-14 shows a typical welded horn type cleat. Details of the cleat size and strength can be found on NAVSEA Dwg Nos. 804-860099 and 804-2276338. Some cleats are retractable (see Figure 582-1-3).



Chock Dimensions with Corresponding Rope Sizes

Chock Size	Max Size Rope (circum.) (inches)	Breaking Strength of Rope (lbs)	Dimensions (inches)				
			A	B	C	D	E
6	3	26,800	6	3	8-1/8	5-1/4	13
10	5	73,000	10	5	11-1/4	6-1/2	19
13	6-1/2	123,000	13	6-1/2	13-7/8	7-1/2	23
16	8	181,000	16	8	16-3/4	9	28
20	10	277,000	20	10	25-3/4	16	38-3/4
24	12	417,000	24	12	25-1/4	13-1/2	40

Figure 582-3-4 Navy Standard Closed Chock

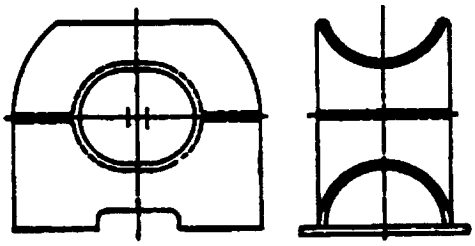


Figure 582-3-5 Panama Canal Chock

582-3.1.10 RETRACTABLE BITTS, CLEATS AND CHOCKS. Retractable bitts, cleats and chocks are similar to Navy Standard fixed bitts, cleats and chocks, except they incorporate special features that allow them to be retracted down (by rotating about their axis) into the hull or ships structure. While underway, they are stowed or retracted in a position which presents a flush surface with the hull or weather deck. When in the unstowed or operating position for mooring, they meet the same requirements in appearance, function and strength as standard or fixed bitts, cleats and chocks. Test procedures and requirements for retractable bitts, cleats and chocks are the same as for standard or fixed fittings, which are specified on the applicable NAVSEA drawing identified in Appendix A, except for operability testing.

582-3.1.10.1 Operability and Stowage Test. To ensure that the retractable bitts, cleats and chocks meet the requirements of operability and stowage after the strength test as specified on applicable drawing, the following test shall be performed. Newly installed, repaired or modified retractable fittings shall be rotated or lifted through three cycles of open-close-open to verify proper operation and fit. The securing fittings for the retractable bitts, cleats and chocks shall be inspected for corrosion, damage or deformation which would degrade the strength of the fitting. Repair as necessary (see Figure 582–1–3 for retractable cleat; Figure 582–3–7 for retractable bitt; Figure (TBD) for retractable chock, submarines; and Figure (TBD) for retractable chock, surface ships).

582-3.1.11 CAPSTAN.

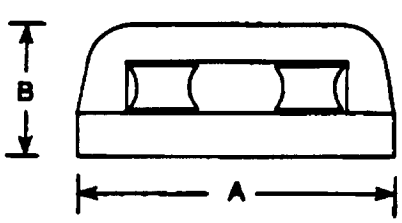
582-3.1.11.1 Description. A capstan is a piece of deck machinery used for warping or heaving in mooring lines. The two powering systems commonly used for capstans are direct-connected electric motor drives (also called electromechanical drives) and electrohydraulic drives. The advantage of electrohydraulic systems is that they permit finer control of warping speed.

582-3.1.11.2 Capstan Machinery. The machinery for the capstan is frequently located below deck, with the controls conveniently mounted on deck near the capstan head. Capstans are generally designed to rotate in both directions. An electric friction brake is fitted so that the gypsy head (horizontal shaft) or the capstan head (vertical shaft) may be braked for controlling line speed. Figure 582-3-13 shows a typical capstan installation.

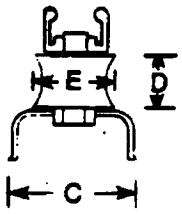
582-3.1.11.3 Self-contained Capstan. When a self-contained unit is installed on the weather deck, the machinery is enclosed in a watertight casing with access openings for inspection, adjustment and maintenance.

582-3.1.11.4 Drawings and Mil-Specs for Capstans. The dimensions for the size of capstan and gypsy heads are found on NAVSEA Dwg. No. S2601-860303, Capstan and Gypsy Heads. Electric capstans are built to comply with mil spec MIL-C-17944.

582-3.1.12 SEPARATORS (FENDERS AND CAMELS). Berthing facilities and ships are subjected to impact loads during docking, undocking and while the ship is moored alongside a pier or wharf structure. Such impact loads may cause damage to the ship and dock structure if suitable facilities are not provided to decrease their harmful effects by absorbing or dissipating the energy of impact. Marine fender systems are classified as either fixed or resilient. The fixed type, which have minimal capacity to absorb impact energy, may be timber facing on a flexible (timber) pier structure or mounted on the face of a rigid pier or wharf structure that is not subjected to large docking forces. Resilient fenders have the ability to absorb sizable amounts of impact energy and are generally designed for specific loads and deflections. With the exception of the fenders carried by the ship, fenders and camels are the responsibility of NAVFAC.



FRONT VIEW



SECTION VIEW

Table of Roller Chock Dimensions (Inches)

A	B	C	Roller	
			D (Height)	E (Largest diameter)
55–3/8	22–3/4	18–1/4	8–1/8	12

Figure 582-3-6 Roller Chock

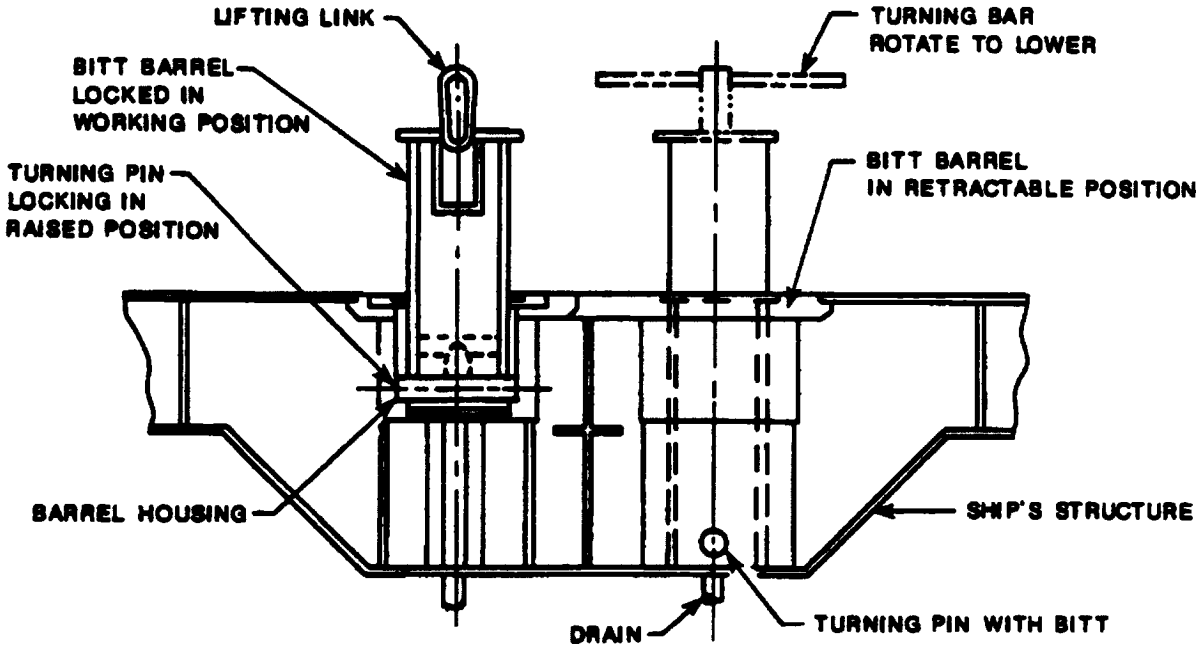
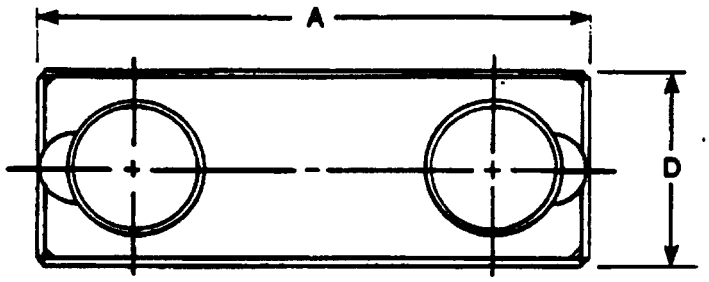
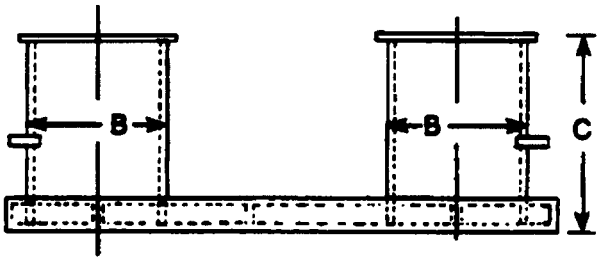


Figure 582-3-7 Bitt (Retractable)



TOP VIEW



FRONT VIEW

Dimensions of Bitt for Synthetic Rope

Nominal Size	Maximum Size Synthetic Rope Circum. (In.)	Dimensions (In.)			
		A	B	C	D
4	3	16-1/2	4-1/2	13-5/8	7-1/2
8	5	28-5/8	8-5/8	16-11/16	13-5/8
10	6-1/2	36-3/4	10-3/4	20-13/16	17-1/4
12	8	44-1/4	12-3/4	26-5/8	20-1/4
14	10	52-1/2	14	31-15/16	22-1/2
18	12	64	18	38-1/4	28

Figure 582-3-8 Bitt (Fixed)

582-3.1.12.1 Camels. Camels are used to protect a fender system from damage due to the motion of moored ships and, where necessary, to provide proper clearance between a ship and a wharf or pier. Camels are floating separators which can be attached to a fender system, the wharf, pier, or the ship itself. For an example see Figure 582-3-15.

582-3.1.12.2 Fenders. Fenders are also made of compressible material like rubber, but they can also be a framed system placed against the edge of a dock to take the impact from a berthing or berthed ship. See Figure 582-3-16 for an example of a fender. See **NSTM Chapter 611, Fenders and Separators** for more information on fenders.

582-3.1.12.3 Separators. Separators can be a combination of camels, fenders and structural members. See Figure 582-3-17 for an example.

582-3.1.13 CONSTANT-TENSION MOORING WINCH. A constant tension mooring winch is a device used to maintain a preset tension in a mooring line after the ship has been tied up to a pier or wharf. The constant-tension feature automatically adjusts for changes in tide or ship's draft by paying out or hauling in the mooring line while maintaining a constant tension in the line. When constant-tension mooring winches are used, two or more are installed forward and two or more are installed aft.

582-3.1.13.1 Navy Constant-Tension Mooring Winches. The Navy uses wire rope for mooring lines on their constant-tension mooring winches. The Navy uses two winch configurations; one is a simple winch with a drum for tensioning the wire rope mooring line, the second also has a drum for the wire rope but is fitted with a gypsy head for handling synthetic line. Constant-tension mooring winches are installed on the T-AO Class of tankers.

582-3.1.14 EFFECT OF MOORING LINE COMPOSITION. Moorings which incorporate wire ropes are considered **stiff** moorings and allow relatively little movement of the moored ship under applied loading. This is advantageous at some mooring facilities where unloading operations require minimal ship motion. The disadvantages of moorings incorporating wire ropes are that wire ropes are more difficult to tend than synthetic lines. Variations in tide levels can dramatically increase line loads and **stiff** moorings may respond poorly to dynamic loads. Moorings which incorporate synthetic lines (that is, lines composed of nylon or polyester) are moorings which permit relatively large movement of the ship under applied loading. Synthetic lines are easier to handle than wire rope. Also, an increase in line load caused by a variation in tide level is not as severe in a synthetic line as it is in a wire line. A summary of mooring configurations is shown in Table 582-3-3.

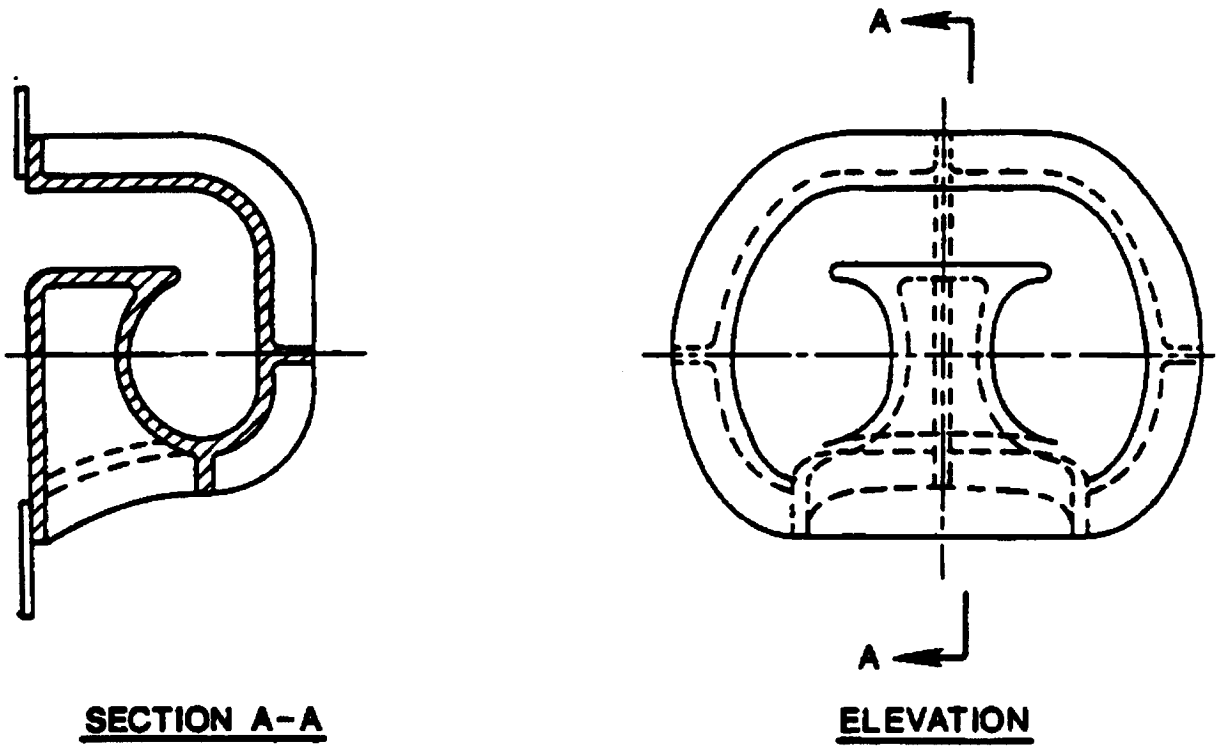


Figure 582-3-9 Bitt (Recessed Shell)

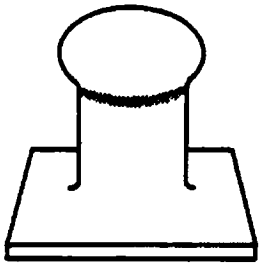


Figure 582-3-10 Bollard

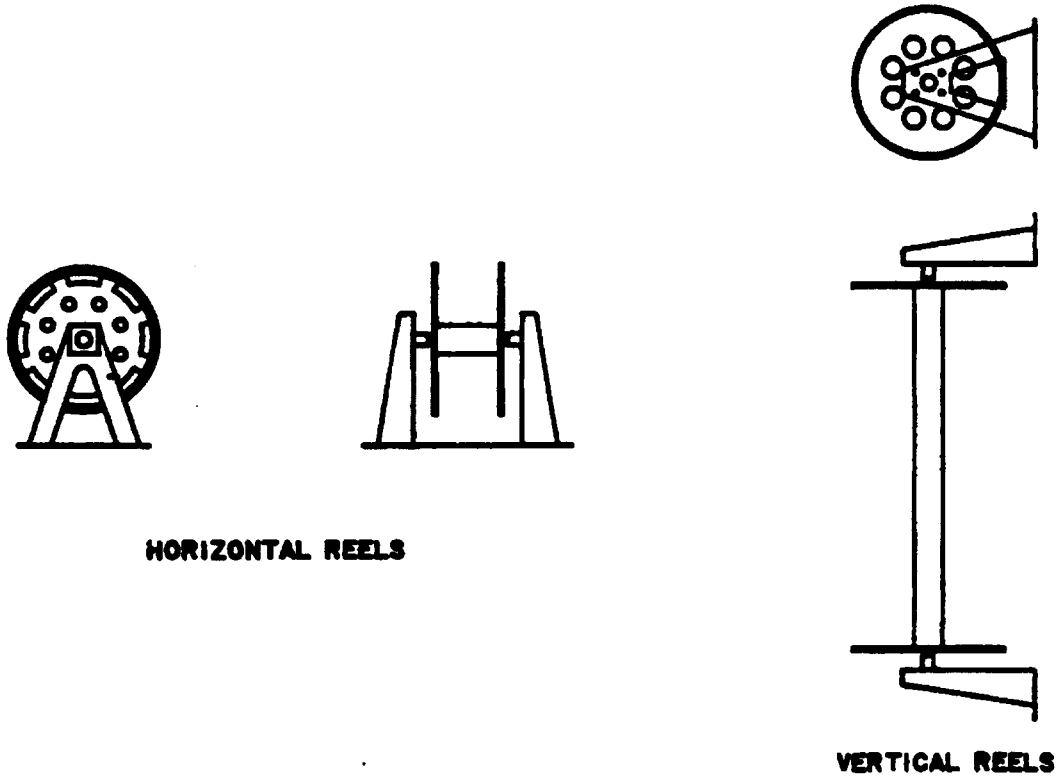


Figure 582-3-11 Hawser Reels

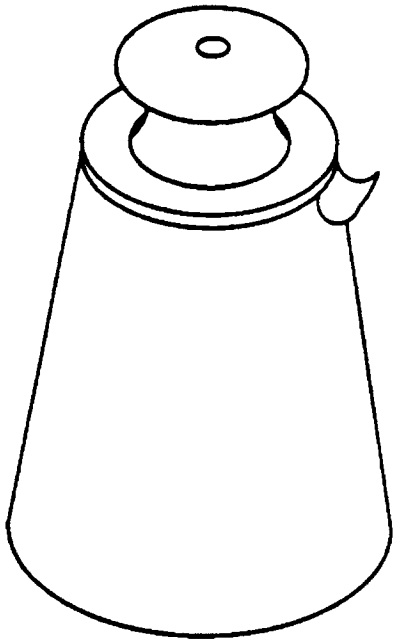


Figure 582-3-12 Fairleader

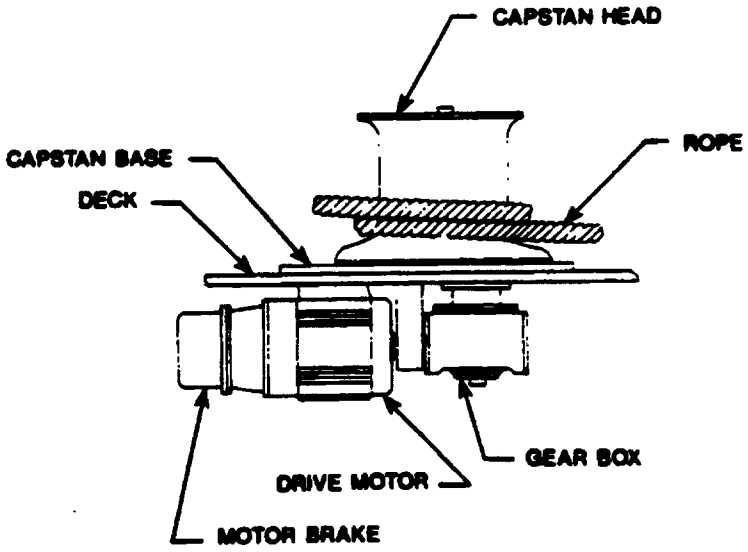
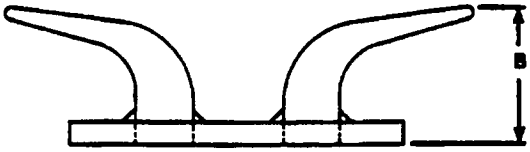
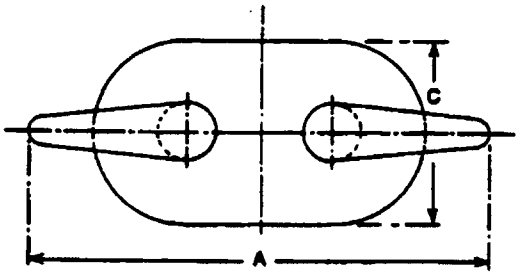


Figure 582-3-13 Capstan



FRONT VIEW



TOP VIEW

Dimensions and Test Loads for Welded Horn Type Cleats

Cleat Size	Dimensions (In).			Largest Applicable Fiber Rope Circum. (In.)*	Cleat Test Load (lbs)
	A	B	C		
5	5	1-5/8	2-5/8	1	2700
6-1/2	6-1/2	2-1/16	3-3/8	1-5/16	5200
8	8	2-1/2	3-3/4	1-1/2	6900
10	10	3-1/16	4-1/2	1-3/4	9000
12	12	3-5/8	5-1/4	2	12,200
14	14	4-1/4	6-3/8	2-1/2	18,400
16	16	4-7/8	7-1/2	3	27,000
18	18	5-1/2	8-1/4	3-1/2	36,000
20	20	6-1/8	9-3/8	4	48,000
22	22	6-3/4	10-1/2	4-1/2	60,000
24	24	7-3/8	11-5/8	5	73,000
26	26	8	12-3/4	5-1/2	90,000
30	30	9-1/8	14-1/4	6	106,000
34	34	10-1/4	15-3/8	6-1/2	123,000
* Applicable fiber rope may be nylon, polyester or manila with a breaking strength not greater than the corresponding cleat test load.					

Figure 582-3-14 Cleat

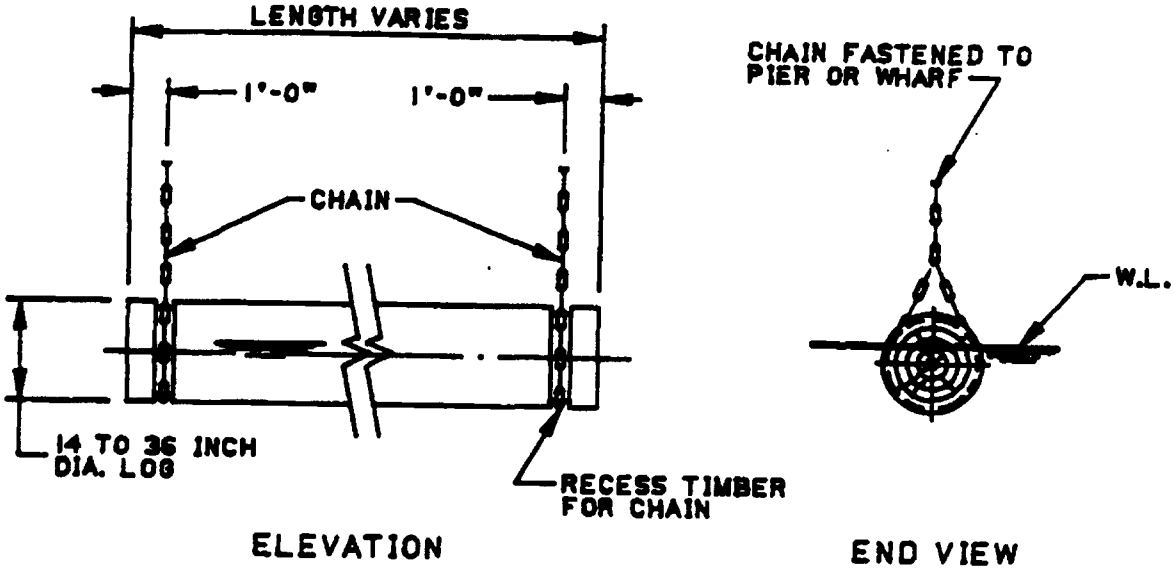


Figure 582-3-15 Camel

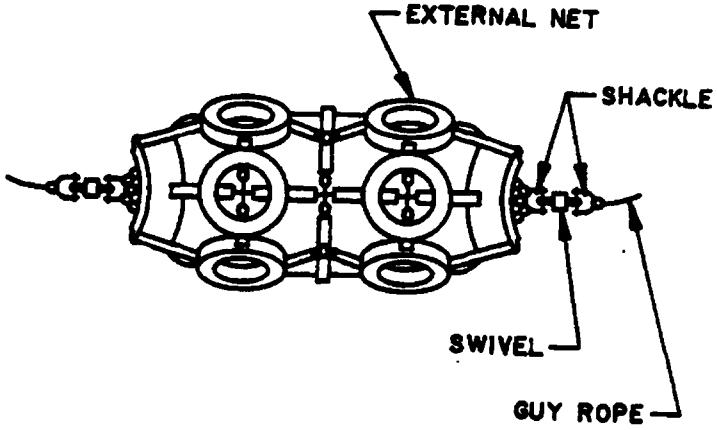


Figure 582-3-16 Fender

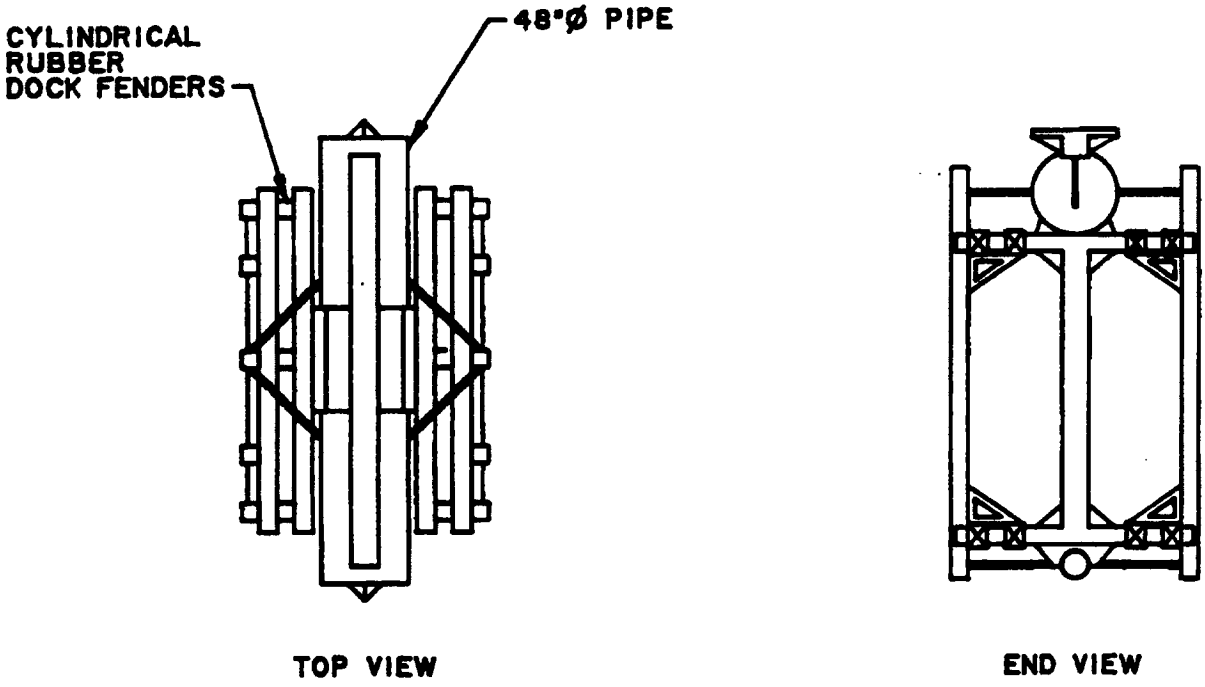


Figure 582-3-17 Separators

Table 582-3-3 MOORING CONFIGURATION SUMMARY

Configuration	Positioning Capability	Remarks
Free-swinging (single-point)	Minimal; large excursion as ship swings to align with wind or current	Ship will assume the most advantageous position under combined action of wind and current; best for heavy weather or transient mooring
Bow-and-Stern (Two-point)	Minimal; limits swing somewhat, large excursions for loads slightly off centerline	Not for precise positioning; suitable for transient mooring with limited sea room
Med-type	Relatively good; longitudinal axis of ship should be oriented toward largest load	Good for situations where reasonably precise positioning is required in a limited area
Dockside	Excellent, ship is aligned parallel with pier or wharf	Best if ship's draft does not limit its ability to tie up. Ship is located near facilities. Easy access provided to take on supplies, ammunition and crew.

SECTION 4.

MOORING SAFETY PRECAUTIONS

582-4.1 LINE HANDLING

582-4.1.1 SAFETY PRECAUTIONS WHEN HANDLING MOORING LINES. When using synthetic fiber lines, there are certain safety precautions that must be observed. Consult **NSTM Chapter 613, Wire and Fiber Rope and Rigging** , for a complete listing of precautions to be observed when handling synthetic fiber ropes. Some of the more important safety precautions are:

WARNING

Ropes may slip suddenly on easing-out, causing injury to line handlers. They stretch under load, recover rapidly and have a low coefficient of friction.

a. Exercise extreme care when easing out or checking synthetic lines under heavy load from around bitts, cleats or other holding devices. For control in easing-out, as recommended in **NSTM Chapter 613, Wire and Fiber Rope and Rigging** , take no more than two round turns on a cleat or bitt. For checking a line under strain, take two round turns followed by no more than two figure-eight bends because figure-eight bends tend to lock-up and surge unexpectedly. The use of figure-eight bends in easing-out or more than two figure-eights in checking will present a danger to personnel and cause extreme difficulty in handling lines.

b. Figure-eight bends can cause problems especially when used on synthetic fiber ropes. With these ropes, the figure eight bends lock-up under heavy strains and, when the rope thins, slip suddenly. The rope then surges so rapidly that it often rides over the top of the bitts.

WARNING

Post safety observers to ensure that line handlers stand as far away as possible. This is particularly important in mooring operations.

c. Line handlers should stand as far away as possible from the securing devices being tended or worked to minimize the possibility of being pulled into the device when the line suddenly surges.

d. Nylon ropes, on parting, are stretched nearly one-half their original length. This length is recovered instantaneously on parting, causing snap back with hazardous force. In view of this danger, it is imperative that no one stand in the direct line of pull when heavy loads are applied on the line. Polyester rope is stretched nearly one-third its original length and is equally dangerous as is aramid rope, which stretches six percent. Table 582-4-1 shows the approximate elongation of nylon, polyester and aramid ropes at break. These elongation percentages were taken from the mil specs and commercial item descriptions for the ropes. To educate the ship's crew, especially line handlers, about synthetic line snapback, the Navy has prepared a video training tape called ″Synthetic Line Snapback″, Order No. 82971DN, 1982. This tape is available from:

1 East coast: Naval Education and Training Support Center, Atlantic Code NS, Bldg. W-313 Naval Station, Norfolk, VA 23511.

2 West coast: Naval Education and Training Support Center, Pacific Code N5, San Diego, CA 92132.

e. Four-strand aramid ropes are designed to fail sequentially, meaning that one of the four strands will fail before the other strands. However, this has only been demonstrated on 50-foot test lengths. Regardless of the length of line out when under tension, this line should be treated with the same respect afforded other synthetic mooring lines made of nylon or polyester.

Table 582-4-1 ROPE ELONGATION

Type	Approximate Elongation at Break (percent)		
	Nylon	**Polyester**	**Aramid**
Three-strand	55	35	-
Double-braided	40	30	-
Plaited	65	45	-
Four-strand	-	-	6

WARNING

The line handling supervisor must ensure the line is clear of obstructions and free to run before applying a train.

f. Never stand in the bight of a line or in the direct line of pull when the line is being pulled or is under tension. See Figure 582-4-1 for the safe work areas of a line when it is being worked. The Navy video training tape ″Synthetic Line Snapback″ is recommended for line handlers. The tape clearly shows safety zones that should be observed when handling lines. If a line hangs up on a deck fitting, it becomes a ″bowstring″ that can slip free at any time with lethal force.

g. A safety observer for the line handling team should be specifically assigned and should not have other duties that would detract from observing the evolution and taking action to stop an unsafe action.

h. When using machinery to heave on a synthetic line under heavy or impact loading, six or more turns should be taken on the capstan or gypsy head plus two riding turns (Figure 582-4-2). These extra turns will help reduce the hazard of a sudden surge when the line is being lead out.

i. Synthetic lines that will be loaded up to or near their safe working load (SWL) should be fitted with tattletales. This cord, which is fitted to the synthetic line, will become taut when the line is tensioned to its SWL. See **NSTM Chapter 613, Wire and Fiber Rope and Rigging** for tattletale dimensions.

WARNING

Heavy strains on wet nylon mooring lines should be avoided whenever possible.

j. Whenever possible, wet lines should be dried thoroughly before stowing. Sometimes drying is not possible before the mooring lines are stowed. If line must be stowed wet, it should be laid up on gratings in long fakes so it may dry as quickly as possible. The wet rope should never be covered. Nylon loses 15 percent of its strength when wet but regains that strength after drying out.

k. Do not mix lines of significantly different stretch (elongation) since the loading between them will not be equal, resulting in premature failure of the line with the least stretch.

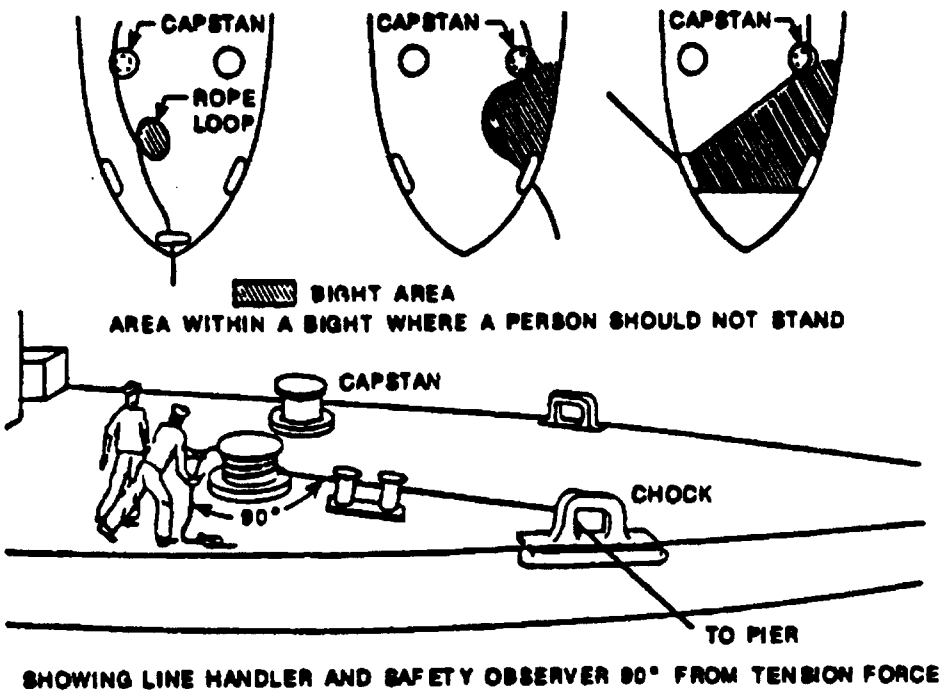


Figure 582-4-1 Safe Work Areas for Line Handlers

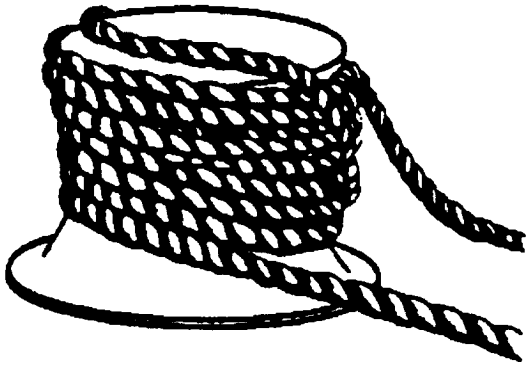


Figure 582-4-2 Capstan with Over-riding Turns of Line

582-4.2 CONSIDERATIONS FOR HEAVY WEATHER MOORING

582-4.2.1 RESPONSIBILITIES. Commanding Officers are responsible to use all means available and weather information to avoid or minimize ships loss or damage. General planning for destructive weather in port and at sea is covered in OPNAVINST 3120.32 (**Ships Organization and Regulations Manual**), and various instructions issued by area, base, and shipyard commanders. Experience has shown that due to the unpredictability and severity of the effects of high winds, seas, and storm surge, it is not possible to guarantee the safety of a moored ship during heavy weather. For ships in port, the best way to avoid this damage will normally be to put to sea or sortie to protected storm anchorages. These steps are normally covered in heavy or destructive weather plans issued by area commanders. For those ships in port and unable to get underway, due to disablement or repairs which cannot be completed, the following guidance should be considered to reduce the risk of damage to the ship

from the effects of destructive weather. The guidance is general and not ship-specific, and is intended to be used along with good seamanship and sound engineering judgment for any given heavy weather scenario.

582-4.2.2 ANCHORING CONSIDERATIONS.

a. U.S. Navy ship anchoring systems are designed to hold the ship in sustained winds of 70 knots and 4 knots of current in 40 fathoms of water with firm sand bottom, when the anchors and chains are properly used. (Some smaller ships have less depth capability.) The ability of the anchoring system to hold the ship fast to the bottom is dependent on current, type of bottom, depth, scope of chain used, and the dynamic forces as the ship swings. The employment of an additional anchor in an arrangement such as the hammerlock moor may extend the effectiveness of the anchoring system beyond its design capabilities during heavy weather. If available, use of a properly maintained buoy of sufficient capacity to hold the ship is preferable to use of the ships anchors.

b. If the holding ground is rated as good, and there is sufficient shelter from wave action, use of the ships anchors may be the best course of action. If possible, the anchoring should provide gradual shoaling of a sand bottom over as wide a range of bearings as possible to minimize the damage to the ship should it drag and ground. The anchorage should also be selected based on the presence of other ships in the anchorage which may drag down onto own ship or foul own ships ground tackle, and the availability of tugs to move the ship.

c. Hammerlock moor. The effective holding power of the anchor can be improved by using a hammerlock or foul weather moor. These are discussed in **Knights Modern Seamanship** , and in **Boatswains Mate Vol 2** , NAVEDTRA 12102. In this moor, one anchor is deployed on a long scope, approximately 30 degrees facing into storm wind rotation, while the other is deployed on a short scope at nearly a right angle to the other anchor chain. The second anchor will then act as a snubber by dragging and limiting the ships yawing in heavy waves and high winds. Properly executed, the hammerlock moor will adjust itself to the shifting winds of a hurricane or typhoon by allowing the short scope anchor to drag as it comes under increased load. The short scope anchor should be deployed on the side toward the expected wind shift. For example, if the wind is expected to back, the port anchor should be dropped. If the eye of a tropical storm will pass directly over the ship, a reversal of the wind direction will be experienced. In this case the short scope anchor should be hauled in until it is just underfoot as the eye passes over so that the ship can swing to the new wind direction without fouling the anchor chains. More chain can then be veered as the ship yaws to its maximum extent toward the wind shift to return to a hammerlock moor. If the ship begins to drag the long scope anchor, more chain can be veered to both anchors until the short scope anchor also holds solidly. The ship propulsion system and steering system, if available, may be used to reduce the load on the anchors.

582-4.2.3 MOORING TO A PIER, WHARF, OR DOCK. The mooring systems installed in U.S. Navy ships have been designed for 50-knot beam winds and 3 knots of current. Their ability to hold the ship fast depends on the use of the correct lines made up properly. Figure 582-2-11 shows the correct method for doubling-up lines: in addition to the single part of a mooring line at each bitt, pass a bight of the line to the bollard on the pier, resulting in three parts of the line holding the ship at that point. To ensure that the three parts of the line take an equal strain, take a simple round turn to the first barrel of the ships bitt closest to the chock before passing the bight to the pier. After the slack is taken out of the bight, and the three parts are under equal tension, fairlead the standing part to the second barrel, then figure-eight the line. Communications to the line stations should be established with consideration of the high background noise generated during hurricane force winds.

a. Mooring alongside a pier. Successful mooring in destructive weather without incurring damage will be extremely difficult, particularly in tropical storms when a wind direction reversal is expected or when storm surge is expected to enter the harbor. It is important to minimize the ships surging, either parallel or normal

to the pier, to prevent line chafing or pounding of the hull against the pier or fendering system. Badly chafed lines will not achieve their expected breaking strength. Loss of any lines in these conditions may result in cascading failure of the remaining lines. Low stretch lines, either aramid or wire rope, can be used to hold the ship, but these require greater tending during changes in water level or wind direction to ensure that neither significant slack nor excessive strain occurs. If low stretch lines are long and steep vertical angles are avoided, the lines can work effectively without tending. A moor using nylon or polyester lines will benefit greatly from the use of extra breast and spring lines to minimize ships movement. These lines will generally perform better than lines with less elasticity. The practice of deploying an anchor underfoot is of limited value. Deploying an anchor away from the dock with catenary in the chain will be more effective in helping hold the ship off the pier and damping surging.

b. Nested mooring. Not all ports offer pierside berthing accommodations to each ship. When port loading is congested, ships may be required to moor outboard similar ship hulls (nested). Prior to periods of gusting winds and inclement weather, the following measures are recommended to augment ships mooring arrangements to reduce possible damage. (However, nested mooring should be avoided if at all possible during heavy weather.)

   1 The pierside ship should be placed on sea cushions vice metal or wooden camels to aid in mooring line shock loading and decreasing possible hull damage from a rigid fendering system.

   2 The pierside ships mooring arrangement should conform to that depicted in Figure 582-2-12. The addition of bow and stern breast lines in conjunction with waist breast lines will provide the best holding power for both ships when nested, inasmuch as the dynamic forces on pier fixtures are greatly increased during this situation.

   3 The outboard ship should be resting on a minimum of two sea cushions positioned to provide best load distribution.

   4 The outboard ships mooring arrangement should include as many lines as possible consistent with own ships bitt and chock design specifications. All lines should have a moderate strain to prevent sea cushions from shifting and ships fore/aft movement. If possible, additional lines should be run from the outboard ship(s) to the pier or wharf, as stated in the caution in paragraph 582-1.2.

c. Use of the pierside anchor chain. The anchor may also be removed from the pierside anchor chain and the chain used as part of the mooring system. The chain should be connected to a high capacity fitting, and can be particularly effective if used in conjunction with an energy-absorbing link. Anchor chain is commonly used for inactivated ships as part of their moor.

d. Pier fittings. Whenever possible, heavy weather mooring lines should be spread out to fittings (bollards preferred) across the pier to maximize the horizontal component of line pull. Limiting the use of a pier fitting to a single ship is recommended wherever practical. The use of extra lines to minimize surging will require caution to ensure the fittings are not overloaded.

e. Wire ropes. Wire rope mooring lines require more tending than most synthetic lines (particularly for shorter lengths) to ensure that all lines are properly sharing the load. If used, they can provide better positioning of the ship, and when properly tensioned will prevent the ship from building up significant dynamic energy from surging. If the ship is surging significantly, the peak loads in the wire rope will be much higher than in nylon or polyester lines. This often will result in parting of the wire rope or failure of the mooring bitts when shock-loaded by the slack that is suddenly taken up by the ships motion. The failure of a single line then can result in a cascading failure. Pretensioning wire rope lines will not only help to limit ship motion but will also ensure load sharing of the lines. Use of an energy-absorbing link is very beneficial with these lines. Wire ropes should be avoided as the primary mooring lines where significant storm surge is expected.

f. Aramid fiber lines. Aramid fiber lines have characteristics similar to wire rope in that their low stretch will require more tending (particularly for shorter lengths), but they are easier to handle due to their light weight

and flexibility. Pretensioning aramid fiber lines is required to minimize ship movement and ensure load sharing. Chafe protection of these lines is extremely important. Use of an energy-absorbing link with these lines is beneficial.

g. Nylon and polyester lines. Nylon and polyester fiber lines are the best choice where high storm surge is expected. Relatively greater elasticity than either wire rope or aramid fiber will provide improved load sharing between parts of the mooring line and between the lines as the ship moves alongside the pier. They should require less tending when initially set up correctly, and are the best choice if tending is impractical. Pneumatic fenders are preferred over camels for nylon or polyester lines because the energy stored in the lines as they stretch will cause a rapid return of the ship to the pier during a lull, and this can capsize a camel and cause damage to the hull. Since the high winds will generate high loads in the lines, personnel should be especially aware of the hazards of pronounced snapback if the line parts under load.

h. Guidance on mixing lines. Wire and fiber rope should not be mixed as the primary load carriers in a heavy weather mooring setup. (Exception: wire and aramid may be used together if the wire lines are used for the longer mooring lines and the aramid is used for the shorter mooring lines.) In an all-fiber rope system, nylon or polyester should not be mixed with aramid lines. Wire or aramid ropes may be used to back up nylon or polyester lines, but must be left with sufficient slack such that they will not come under significant tension until the more elastic synthetic lines have stretched to store as much of the load as possible without parting. This will allow the primary lines to absorb and dampen a significant amount of the dynamic energy created by the motion of the ship in the wind before any significant load is placed on the backup lines. A number of additional factors must be considered in developing a mooring plan with mixed lines: strength of bitts, bollards and cleats, estimated residual strength of lines to be used (e.g., nylon will lose approximately 15 percent of its strength when wet), estimated magnitude and direction of the sustained and gusting wind, expected current, and height of the storm surge. Using these considerations, the length of the wire rope or aramid backup storm line should be determined (including length of energy absorbing link if used) so that they will become taut when the primary mooring line reaches a load of approximately 50 percent of estimated breaking strength. To determine the correct amount of slack (i.e., additional length of rope to be payed out after the line is taut) for rack wire rope or aramid storm line, multiply the following factors (given in Table 582-4-2) times the taut length (ships bitt to the pier bollard):

Table 582-4-2 SLACK DETERMINATION FACTORS

Factor	Primary Mooring Lines
0.20	Nylon 3-strand, nylon double-braid, nylon 8-strand plaited
0.04	Polyester double-braid
0.07	Polyester 8- and 12-strand plaited
0.10	Polyester 3-strand
0.14	Polypropylene 3-strand

If the wire rope or aramid backup line cannot be run in the same direction or have the same length as the primary line, then the relative geometry will be different and the required additional slack will be different from that derived above.

i. Energy-absorbing links. Marine energy-absorbing links, such as the Seaward International Corp Sealink or equivalent, may be available in some ports. When used as part of the mooring, a properly sized energy-absorbing link in the line load path can greatly reduce line chafing and the peak dynamic load on bitts, bollards, wire rope, aramid rope, and anchor chain.

j. Importance of chafing gear. Chafe will be a severe problem for both wire and fiber ropes used for a heavy weather mooring. Wire rope is the least vulnerable. Aramid is the most vulnerable. To reduce chafing, the distance between the bitt and the chock through which the line is led should be minimized. Chocks and any other

surface over which the lines will be pulled under tension should be ground smooth. Fit chafing gear such as leather or canvas covers or sacrificial whippings to absorb abrasion and protect the integrity of the mooring lines. Take special care with the installation of chafing gear since it will be extremely difficult to replace while riding out the storm.

582-4.2.4 CONSIDERATIONS FOR BITTS AND BOLLARDS.

a. Ships bitts. The sum of the breaking strengths of all the parts of wire and fiber ropes attached to the bitt should not exceed the strength of the bitt. Bitts on U.S. Navy ships are generally rated for the static breaking strength of three parts of the normal complement (size, material and construction) of mooring lines. The lines are expected to fail under load prior to any damage to the bitts. Sufficient design allowance is included with the bitts to account for normal deterioration in service. Use of additional mooring lines or lines of higher strength to a bitt to hold the ship should only be done after the Commanding Officer has considered the increased risk of bitt failure under the conditions of this section.

b. Bollards and pier fittings. The same considerations as those for bitts apply to mooring fittings on the pier. Information on their strength may be obtained from the harbormaster for naval bases. Information on the strength of fittings in commercial ports may be more difficult to obtain, and an estimate should be made based on their size and condition. In general, bollards on navy piers are designed to handle mooring the largest ship that will use the pier in a 64 knot (hurricane level) wind according to the berthing plan for the pier. Like the ships bitts, these bollards may handle the loads imposed by the moored ships in more severe conditions, but with greater risk of failure or damage to the pier and the ship. The more redundancy that can be obtained in mooring the ship with balanced loads fore and after, the greater the probability that the moor will succeed.

582-4.2.5 FORCES GENERATED BY HIGH WINDS. The loads in the ships mooring lines increase approximately as the square of the wind speed increase. For example, if the wind speed doubles, the mooring line loads will quadruple. Their magnitude is also dependent on the direction of the wind and the configuration of the ship above the waterline. The following table provides an estimate of the resultant total force generated on several classes of ship to help develop a heavy weather mooring plan appropriate for the conditions anticipated. Only the highest forces (lbs) and the corresponding relative wind bearing are shown.

Table 582-4-3 FORCES GENERATED BY HIGH WINDS

	50 kts	**70 kts**	**100 kts**	**150 kts**
MHC 51 (120/240 DEG)	19,300	37,800	77,200	174,000
DDG 51 (105/255 DEG)	116,000	227,000	463,000	1,040,000
CG 47 (105/255 DEG)	224,000	439,000	895,000	2,010,000
AD 41 (090/270 DEG)	362,000	709,000	1,450,000	3,250,000
LHD 1 (100/260 DEG)	421,000	825,000	1,680,000	3,790,000
CVN 68 (100/260 DEG)	459,000	899,000	1,830,000	4,130,000

582-4.2.6 FORCES GENERATED BY CURRENTS. If a current exists at the mooring site and is moving in the same direction as the wind, it will add to the total force on the ship. The force due to current is dependent on the hull form and draft of the ship, the depth of the water, and the direction of the current. For many surface ships, the force due to a 3-knot beam current is double or triple (or more) the 50-knot wind forces in the table above. Since the mooring system installed in U.S. Navy ships have been designed for 50-knot beam winds and a 3-knot beam current, approximately two-thirds or three-fourths (or more) of the total force on the ship is from the current in the design condition. With all mooring lines properly doubled-up in the design condition, both the

mooring lines and the bitts have a safety factor of three. If there is less current, the mooring system will have a higher safety factor and thus be able to withstand higher winds.

SECTION 5.

CARE AND INSPECTION OF MOORING EQUIPMENT

582-5.1 MAINTENANCE AND INSPECTION OF MOORING LINES AND MOORING GEAR (GENERAL)

582-5.1.1 PMS OF MOORING EQUIPMENT. The Planned Maintenance System (PMS) requirements should be carried out in accordance with instructions provided on the applicable Maintenance Requirement Cards (MRCs).

582-5.1.2 INSPECTION OF SYNTHETIC MOORING LINES. Synthetic mooring lines should be inspected prior to usage or storage. Consult **NSTM Chapter 613, Wire and Fiber Rope and Rigging** for rope inspection guidelines.

582-5.1.3 SURFACE INSPECTION OF ROPE-SUPPORT HARDWARE. Inspect surfaces that the rope passes over for roughness and sharp edges.

582-5.1.4 BREAKING IN NEW SYNTHETIC ROPE. When new synthetic rope is first put into service, abrasive surfaces will cause the outer filaments of the rope to form a fuzzy appearance and texture. This fuzzy appearance is not detrimental to the strength of the rope but actually forms a protective cushion and a shield for the fibers underneath. This condition should stabilize, not progress. If the surface roughness continues to increase, this is an indication that there is excessive abrasion and the rope is losing strength. Rusting iron, when it reacts with seawater, can cause a nylon rope to lose considerable breaking strength. Nylon ropes exposed to iron rust reacting with seawater have been reported to have lost a significant amount of strength in a one-month period. Rope subjected to rust exposure for more than a month should be repaired or replaced.

582-5.2 MOORING GEAR MAINTENANCE.

582-5.2.1 INSPECTION AND MAINTENANCE INTERVALS FOR MOORING EQUIPMENT. MRCs (Maintenance Repair Cards) for deck equipment used for mooring are provided for each ship. The following inspection and maintenance intervals are taken from a typical set of MRCs for a capstan. The actual MRCs for a particular ship should be consulted for details of the inspections to be performed and the recommended intervals:

a. Inspect and lubricate the flexible coupling (semiannually)

b. Inspect oil level in gear case and test operate capstan (monthly)

c. Inspect capstan brake (electrical or mechanical) (semiannually)

d. Clean and inspect capstan motor and lubricate motor bearings (semiannually)

e. Provide lube oil sample for inspection and chemical analysis (semiannually)

f. Clean and inspect controller and control switch (semiannually)

g. Inspect foundation bolts (fasteners) for tightness (annually).

582-5.2.2 LUBRICATION OF MOVING PARTS OF DECK FITTINGS USED FOR MOORING. Deck fittings with movable parts should be lubricated per PMS requirements.

PART 2

TOWING

SECTION 6.

GENERAL TOWING INFORMATION

582-6.1 EMERGENCY SHIP-TO-SHIP TOWING

582-6.1.1 EMERGENCY TOWING. Navy ships have provisions, in an emergency, for being towed and for towing another ship, except carriers and submarines which are only outfitted to be towed. The subject of this chapter is emergency towing. Anticipated or planned tows are discussed in detail in the **U.S. Navy Towing Manual** (SL740-AA-MAN-010) and are not covered here.

582-6.1.1.1 NAVSEA Responsibility for Emergency Towing. The Ocean Engineering and Ship Handling Systems Branch (56W23) of the Naval Sea Systems Command (NAVSEA) is responsible for emergency ship-to-ship towing.

582-6.1.1.2 OOC Responsibility for Planned Towing. The Director of Ocean Engineering (OOC) of the Naval Sea Systems Command (NAVSEA) is responsible for planned towing.

582-6.1.2 TOWING CAPABILITIES OF INDIVIDUAL SHIPS. The requirement for towing disabled ships by other ships in an emergency is referred to as tow-and-be-towed or emergency ship-to-ship towing. The General Specifications for Navy Ships have provisions in Section 582 for providing arrangements for being towed and for towing another ship. The specifications require that the arrangements be in accordance with applicable NAVSEA standard drawings. This requirement means that the ship is capable of towing another ship in an emergency, with each ship carrying half the tow line.

582-6.1.3 TOWING EQUIPMENT. Navy combatant surface ships have a towing pad and stern chock aft and a chain stopper pad (towing pad) and bow chock forward. Sometimes, because of equipment interference, the stern chock and towing pad at the stern are located on the quarter. In addition to these deck fittings, Navy surface ships carry a towing hawser, chafing chain, pelican hook, shackles and other appendages needed for emergency towing operations. Towing hawsers are designed to absorb energy during the tow by stretch in the synthetic hawsers or by vertical movement in the heavier wire rope hawsers.

582-6.1.4 NAVY TUGS AND SALVAGE SHIPS WITH A TOWING CAPABILITY. The Navy has ocean tugs which are capable of long-range tows and other missions. They are the ARS 6/38 and ARS 50 Classes of salvage ships, the ASR 7 Class of submarine rescue ships, the ATS 1 Class of salvage tugs, and the T-ATF 166 and ATF 76 Classes of fleet tugs. All are equipped with automatic towing winches except the T-ATF Class which uses a SMATCO towing winch. For more information on the capabilities of these Navy ocean tugs, consult the **U.S. Navy Towing Manual** (SL740-AA-MAN-010).

582-6.1.5 SUBMARINE TOWING EQUIPMENT. Submarines generally do not carry a towing hawser and associated gear. This equipment shall be provided by the towing ship. Submarines are built with the necessary towing pads, cleats and chocks for being towed. When not in use, the cleats and chocks are arranged to retract and house inside the faired lines of the hull.

582-6.1.6 AIRCRAFT CARRIER TOWING EQUIPMENT. Aircraft carriers are only equipped to be towed. They do not have a padeye or other towing equipment located aft for towing another ship. Carriers are equipped with 2-1/2 inch diameter 6 x 37 galvanized wire rope towing hawsers, 900 feet long. Some carriers are equipped with two 900-foot towing hawsers, while some have only one towing hawser. The towing hawsers are stored in the anchor handling compartment on a horizontal storage reel.

582-6.1.7 TOWING INFORMATION ONBOARD NAVY SHIPS AND SUBMARINES. Each ship in the Navy is provided with a towing drawing that shows how to rig the ship for being towed or for towing another ship. This drawing also shows such details as the size of the towing hawser, chafing chain and other appendages. For surface ships and some submarines, the Ship's Information Book (SIB) has details on the towing gear and also contains diagrams that illustrate how to rig for being towed or for towing another ship. For the later classes of submarines, the Ship System Manual (SSM) can be consulted for towing details. The SIB, SSM and towing drawing(s) should be consulted for the required towing gear and hookup for a particular ship. Figure 582-6-1 shows how to rig ships for emergency towing. It is provided to be used in the absence of ship's drawings and instructions. Figure 582-6-2 shows the towing hawser arrangement to be used for an emergency tow.

NOTE

Figure 582-6-1 and Figure 582-6-2 do not show the size and exact type of emergency towing gear used for the various ship classes. If the ship's towing drawings are not available for this information, consult NAVSEA standard Dwg No. 803-4759441, which shows emergency towing gear assemblies using the Navy standard towing thimble for use with 5-inch through 14-inch circumference synthetic rope towing hawsers. The actual configuration may be different from the type drawing if the thimble and link or rope connector fittings are used.

582-6.1.8 SYNTHETIC FIBER ROPES FOR TOWING. The Navy uses a variety of synthetic ropes for towing hawsers. The demands of the situation determine which type of construction and fiber will be used. Figure 582-6-3 shows the three types of rope construction used by the Navy for towing. Their construction types and characteristics are, in preferred order:

a. Twelve-strand single-braided rope provides ease in inspecting and splicing, is non-rotating and has maximum bearing surface.

b. Eight-strand plaited rope provides ease in inspecting and splicing and does not rotate.

c. Double-braided rope is acceptable but less desirable because it is more difficult to splice. This line is nonrotational. Double-braided ropes also have a firm, round cross section that provides a maximum bearing area. This results in more gripping surface and an ability to disperse heat and abrasion over a larger area to reduce wear.

NOTE

Three-strand twisted rope has high-stretch characteristics and good abrasion resistance and splicing characteristics. However, since it rotates under load, a number of instances of cockling [(line kinking when the load is released) see Figure 582-6-4 (Cockle)] during towing operations have been produced. Three-stranded twisted lines are not recommended for use as towing hawsers.

582-6.1.9 SYNTHETIC FIBER ROPES USED FOR NAVY TOWING HAWSERS. The primary synthetic fiber ropes used by the Navy for towing hawsers are nylon and polyester.

582-6.1.10 NYLON ROPE. Nylon rope has good strength, elasticity, and resistance to weather and is available in braided and plaited construction for towing applications. Nylon loses 15 percent of its strength when wet but regains that strength after drying out.

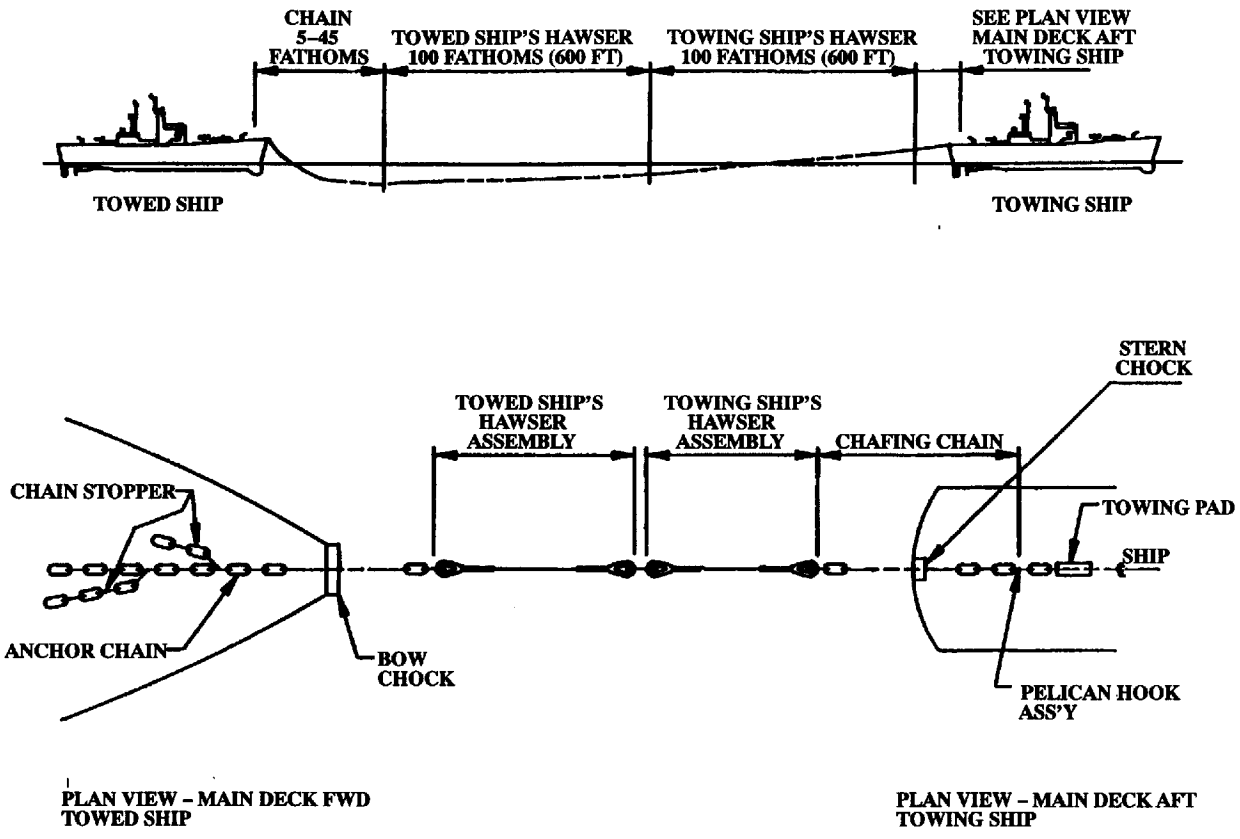
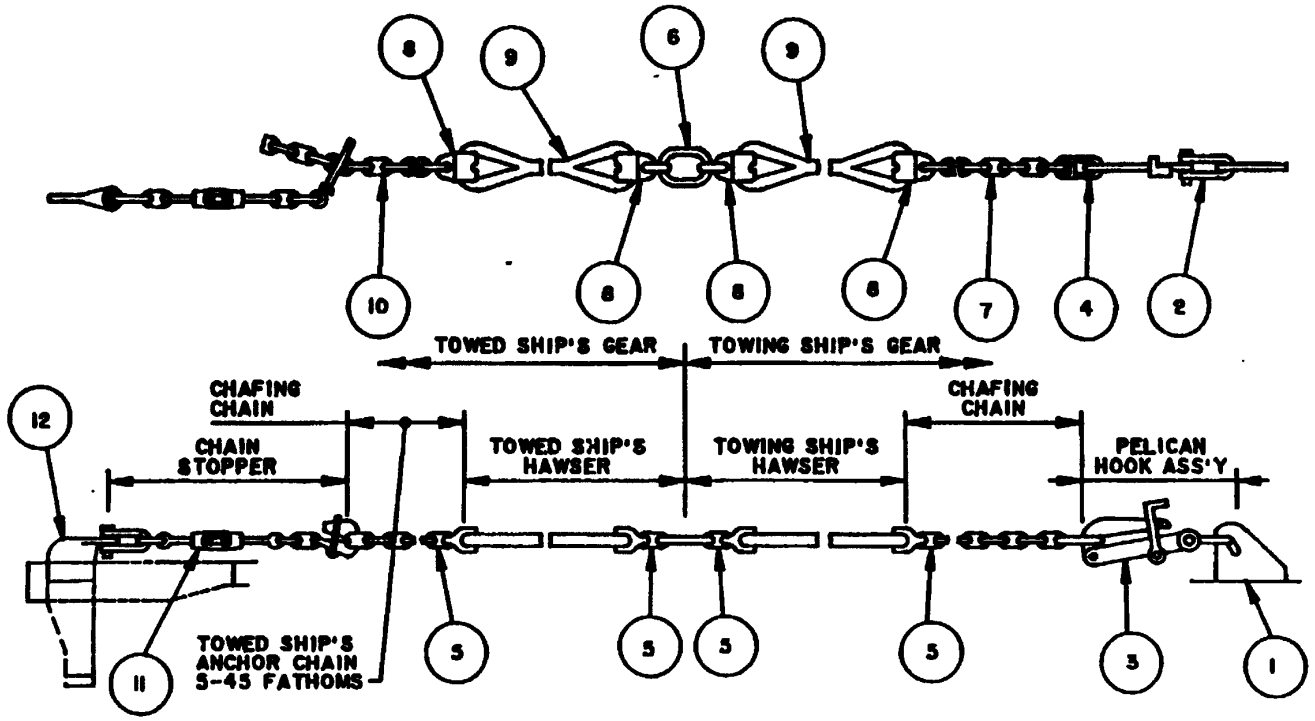


Figure 582-6-1 Emergency Towing Arrangement



ASSEMBLY OF TOWING GEAR

PIECE	DESCRIPTION	PIECE	DESCRIPTION
1	TOWING PAD	7	CHAIN
2	SHACKLE	8	TOWING THIMBLE
3	PELICAN HOOK	9	TOWING HAWSER
4	END LINK	10	ANCHOR CHAIN
5	DETACHABLE LINK	11	CHAIN STOPPER
6	NATO LINK	12	CHAIN STOPPER DECK PADEYE

Figure 582-6-2 Towing Hawser Arrangement

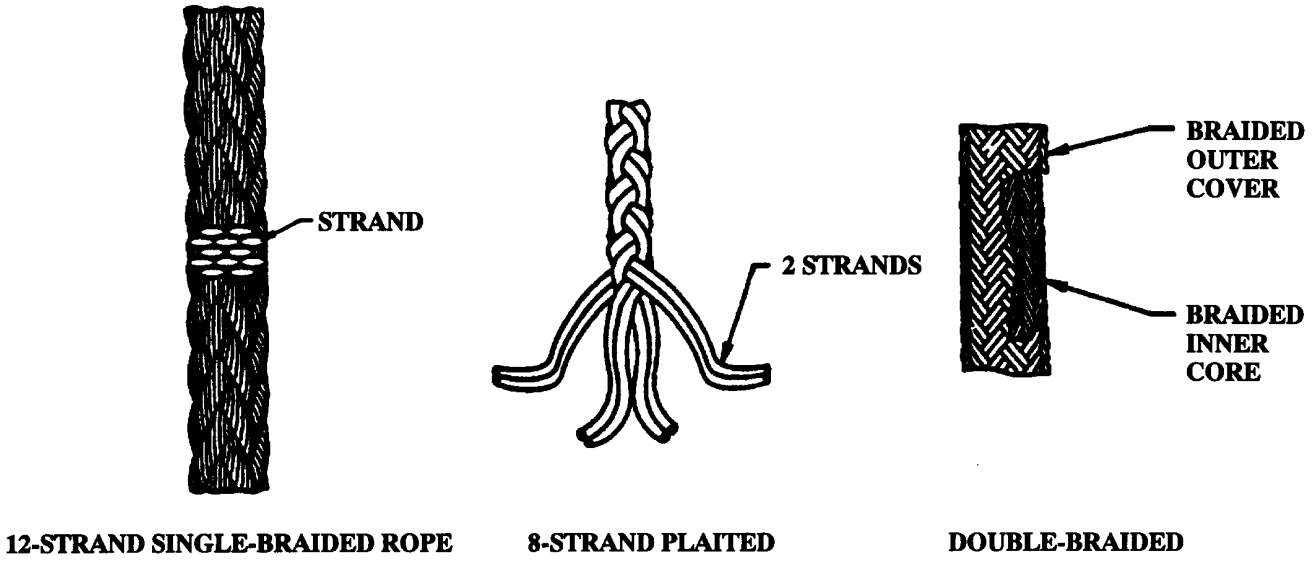


Figure 582-6-3 Rope Construction

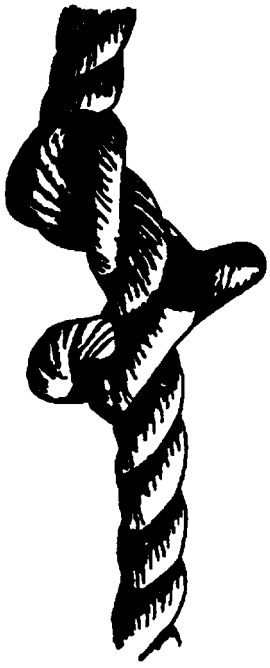


Figure 582-6-4 Cockle

582-6.1.11 POLYESTER ROPE. Polyester rope can be as strong as nylon rope depending on the type of construction, but does not have the stretch and elasticity of nylon rope. Polyester rope does not appear to have the wet strength loss that nylon does. Polyester rope is also available in braided and plaited construction for towing applications.

582-6.1.12 RECOMMENDED TOWING HAWSER SYNTHETIC ROPES. The present recommendation for towing hawser material and construction is to use 12-strand polyester rope made to MIL-R-24750, plaited poly-

ester rope made to MIL-R-24730 or double-braided polyester rope made to MIL-R-24677. Current towing hawsers on board need not be replaced unless they are no longer serviceable.

582-6.1.13 BREAKING STRENGTHS OF SYNTHETIC FIBER ROPES. Tables showing comparative minimum breaking strengths for plaited and double-braided nylon and polyester ropes are found in **NSTM Chapter 613, Wire and Fiber Rope and Rigging** .

582-6.1.14 WIRE ROPE TOWING HAWSERS. Wire rope is also used for towing hawsers. However, for emergency towing, its use is limited mostly to aircraft carriers and older submarines. The wire rope hawsers used for emergency towing are the 6 x 37 class type, improved plow steel (IPS) galvanized.

SECTION 7.

DESCRIPTION OF TOWING OPERATION

582-7.1 PROCEDURE FOR RIGGING AND PASSING A TOW LINE

582-7.1.1 GENERAL. Procedures for rigging and passing a single pendant tow line for a ship-to-ship emergency tow are the same, regardless of ship class. The following general procedure lists the steps for preparing and passing the tow line between two surface ships. Figure 582-7-1 shows a typical tow line rigged for passing to a disabled ship and Figure 582-7-2 shows a ship rigged to be towed using chain stoppers and anchor chain.

582-7.1.1.1 Procedure for the Towing Ship.

1. Connect the pelican hook to the after-towing pad with a shackle.
2. Connect the chafing chain with an end link to the pelican hook. Lead the chafing chain through the stern chock.
3. Connect the towing hawser end fitting to the chafing chain with a detachable link.
4. Fake down the towing hawser clear for running fore and aft. Stop off each bight of the towing hawser to a jack stay with 21-thread. Place shoring under the stops for ease in cutting.
5. Connect the NATO towing link (see paragraph 582-8.1.8 for a description and availability of the NATO towing link) to the free end of the towing hawser.
6. Connect a messenger, composed of approximately 100 fathoms (600 feet) of three-inch circumference line and 50 fathoms (300 feet) of 1-1/2 inch circumference line (for a 10-inch circumference or larger hawser, use the four-inch in place of the three-inch), to the outboard end of the towing hawser. Fake down the towing hawser messenger clear for running fore and aft. Lead the free end of the messenger through the stern chock.
7. Stop off a 6-thread or 9-thread messenger outboard on both sides of the ship from the fantail to the forecastle with sail twine, clear for running. Coil a 600-foot length of 6-thread on the fantail for a third messenger. These messengers are rigged to permit the conning officer greater maneuvering freedom when approaching the ship to be towed.
8. When close enough to the ship to be towed, pass either the port, starboard, or fantail, 6- or 9-thread messenger with a heaving line bolo or line-throwing gun. The forecastle will notify the fantail by telephone as to which side the messenger is being passed so that the appropriate 6- or 9-thread messenger may be connected to the towing hawser messenger. Two methods for connecting a messenger to the tow line are shown in Figure 582-7-3.

9. Pay out the tow line messenger and hawser, cutting the stops of the towline hawser at the 4 x 4 inch to control the speed of paying out, as the ship to be towed takes in the 1-1/2 inch circumference messenger and hawser. The tow line messenger and hawser should be payed out gradually to ease handling of the tow line by the towed ship and to avoid fouling the propellers of the towing ship.

582-7.1.1.2 Procedure for the Towed Ship.

1. Stop off the anchor (port or starboard) of the anchor chain to be used. Set up on the anchor windlass brake. Pass a pinch bar through the chain, letting the bar rest on the lip of the chain pipe, or pass a preventer to prevent the chain from backing down into the chain locker and a preventer on the anchor to back up the stopper. Break the anchor chain at the detachable link inboard of the swivel. If power is available, haul out the desired length of chain using the anchor windlass. If power is not available, the chain will have to be hauled out manually.

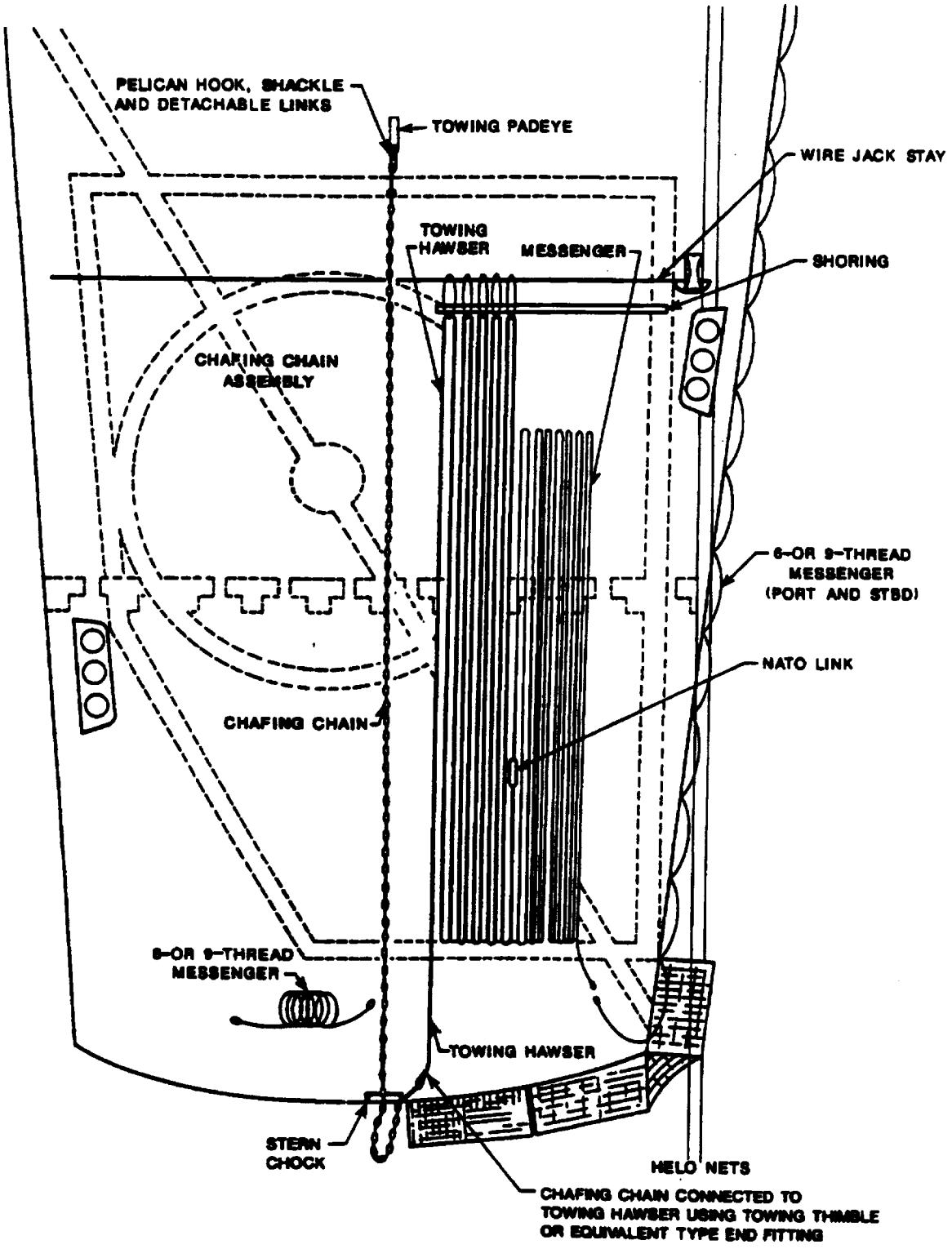


Figure 582-7-1 Ship Rigged to Tow

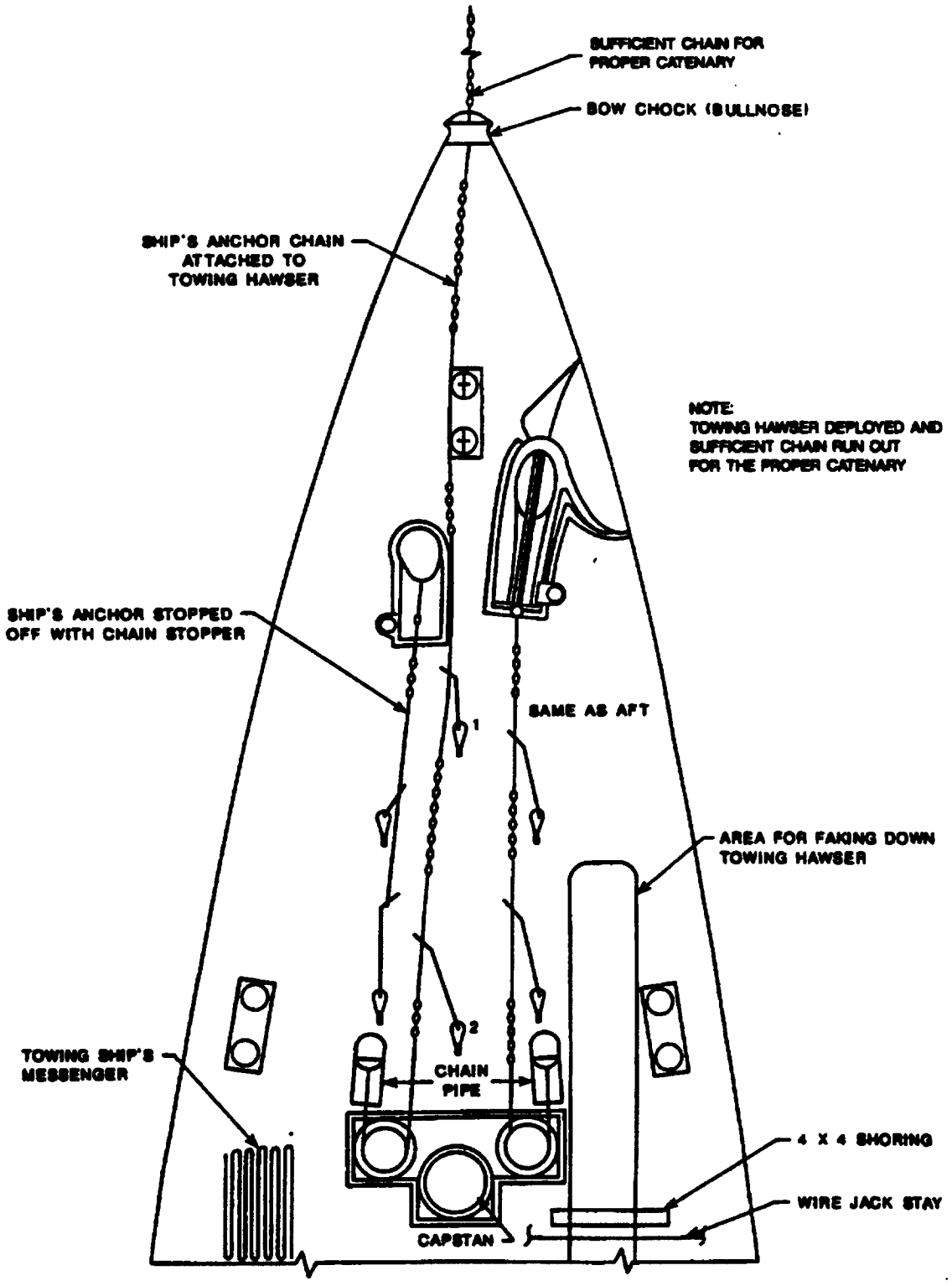
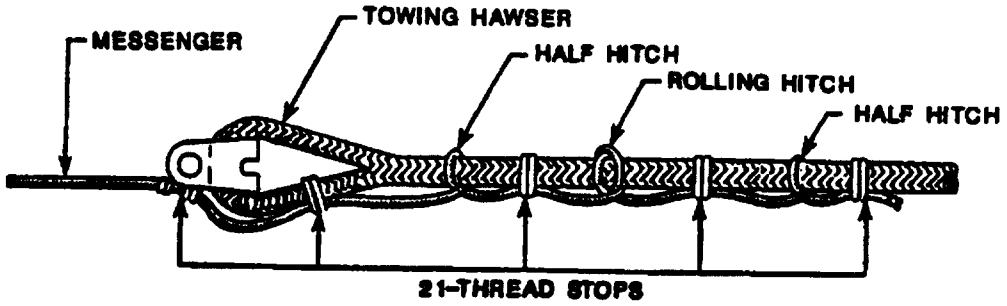
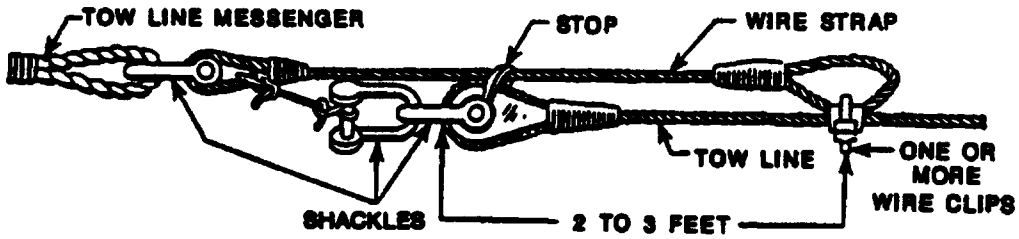


Figure 582-7-2 Ship Rigged for Tow



CONNECTING MESSENGER TO SYNTHETIC FIBER ROPE TOWING HAWSER



CONNECTING MESSENGER TO WIRE ROPE TOWING HAWSER

Figure 582-7-3 Connecting a Messenger to the Tow Line

2. Shackle the towing chain stopper to the designated (towing) padeye on the forecastle, for stopping off the anchor chain after the tow is properly adjusted.

3. Fake out the towed ship's hawser on deck, fore and aft, on the forecastle for clear running, prior to connecting it to the anchor chain. Use the towing ship's messenger to haul the towing hawser from the towing ship on board through the bullnose. Connect it to the towed ship's hawser secured to the end of the anchor chain. If the towed ship's hawser is not to be used, connect it to the anchor chain. Use a detachable link to connect the free end of the towed ship's hawser to the NATO link.

4. Pay out sufficient anchor chain (5 to 45 fathoms [30 to 270 feet]) to provide a substantial towing catenary when the towing hawser has been payed out. Synthetic rope has a very small catenary.

5. Set the brake on the wildcat and pass and equalize the chain stoppers, one outboard and one inboard of the detachable link, to take the strain on the towed ship's anchor chain. Disengage the wildcat.

582-7.1.1.3 Getting Underway with Tow. Implement the following steps when the towing hawsers are connected and both ships are ready to start the tow:

1. Start the towing ship's engines ahead as slowly as possible and stop them when the hawser begins to take strain. Increase turns slowly until the inertia of the tow is overcome and both ships are moving slowly with steady tension in the hawser. Increase speed slowly until the desired speed is reached. At no time should an additional amount of strain be placed on the tow hawser to cause it to lift completely out of the water. The course of the tow may be changed gradually, as necessary.

2. Pay out or haul in (assuming power is available to the anchor windlass) anchor chain as desired to keep the

ships in step (that is, taking wave crests at the same time). When a comfortable distance is found, the chain stoppers are passed on the anchor chain and the strain is equalized between the stopper and wildcat. Locking plates are installed and set on both the chain stoppers.

582-7.1.1.4 Quick Release of Towed Ship. Procedure for quick release (time permitting) of towed ship:

1. Pay out the anchor chain connected to the tow line on board the towed ship so that a detachable link is just forward of the anchor windlass.
2. To prevent the chain from returning to the chain locker when detached, pass the chain stoppers on the anchor chain and lash the anchor chain just abaft of the detachable link or apply the chain compressor where fitted.
3. Disconnect the anchor chain between the anchor windlass and the chain stoppers so that only the chain stoppers are holding the anchor chain and the tow line. This arrangement allows quick release of the towing hawser and chain.

CAUTION

In case of emergency, for quick release, tripping the pelican hook on the towing ship is faster than the above procedures.

582-7.2 SUBMARINE TOWING

582-7.2.1 GENERAL. The procedure for emergency towing of submarines is not as well developed as the emergency towing procedure for surface ships. Surface ships also conduct emergency towing drills to practice their towing skills; submarines, however, do not generally engage in emergency towing drills.

582-7.2.2 CONSIDERATIONS WHEN RIGGING A SUBMARINE FOR TOWING. Rigging the towing gear on a submarine is dangerous. Because of a submarine's limited freeboard and circular hull, the sea sweeps completely over the deck in weather which would be considered relatively calm by the crew of a surface ship.

582-7.2.3 TOWING GEAR PROVIDED ON VARIOUS CLASSES OF SUBMARINES. If the submarine is provided with onboard towing gear, such as the SSN 688 Class, it may consist of a wire rope towing bridle, a wire rope chafing pendant, a flounder plate or pelican hook and link fittings, and a fiber rope towing hawser. The assembled gear is designed to allow towing by means of a forward pair of cleats, which are hinged design on later model submarines (SSN 688 and SSBN 726 Classes). The SSN 637 Class has towing eyes welded to the ship's hull at the base of the leading edge of the sail. In this case, the towing gear consists of two shackles, a pelican hook and a link. One shackle connects the pelican hook with the towing eye, the other holds the tow line. The towing shackle is connected to the pelican hook by means of a link. The pelican hook permits the tow line to be released quickly and safely.

582-7.2.4 PERSONNEL SAFETY. The main deck of a submarine is usually inaccessible and dangerous to board in a seaway. There is very little freeboard, and if there is any sea running, the decks are most likely awash. Use a tether or safety line when moving about the deck. Normally a safety track is provided for attaching personnel restraining safety lines. The necessary fittings and harnesses are carried on the submarine for use with the track.

582-7.2.5 PERSONNEL EXPERIENCE. Personnel on the towing ship may have little or no experience with submarines and may lack familiarity with the peculiar fittings, equipment and limitations of the submarine. Submarine personnel may not be familiar with the deck seamanship evolutions common to surface ship personnel. Good communication between the submarine and the tow ship's crew is essential.

582-7.2.6 SAFETY EQUIPMENT FOR WORK ON THE DECK. All personnel working on the deck when connecting to a submarine in open sea, should wear full wet suits, survival gear or similar dress which will provide thermal protection, as well as flotation, should they be washed overboard. No one should be permitted to work without proper life preservers and other safety equipment appropriate for the task.

582-7.2.7 HANDLING OF TOWING EQUIPMENT. Handling emergency towing gear can be required when the submarine is at sea, possibly in heavy weather. Handling gear and preparing the hinged cleats on the rounded waterswept deck is difficult and hazardous. For this reason, assembly of the towing gear and all possible preparation should be done below deck if the towing gear is provided on the submarine, or on the towing vessel if it is providing all the towing gear.

582-7.2.7.1 Older Submarines. In some cases, especially on older submarines, the available towing gear may have to be modified.

582-7.2.8 SUBMARINE TOW LINE CONNECTIONS.

582-7.2.8.1 Tow Attachment Points.

a. All U.S. Navy submarines have a plan for being towed that is described in each Ship's Information Book (SIB). The arrangements are similar for all submarines built prior to the SSN 688, SSN 21, and SSBN 726 Classes and are described as a group. The SSN 688, SSN 21, and SSBN 726 Class arrangements are described separately. Table 582-7-1 contains relevant technical data concerning towing equipment on several classes of U.S. Navy submarines.

b. Prior 688/21/726 Class Submarines. Most submarines prior to the 688/21/726 Class have tow pads at or near the base of the forward end of the sail or attached to the forward escape trunk. Lateral strength is considerably reduced, so a tow fairlead must be used. The hole in the padeye is 2-9/16 inches in diameter.

   1 Most of these submarines have retractable mooring cleats, forward fairlead chocks and capstans. Many have after capstans and fairlead chocks as well. Inside dimensions of the chocks are 10-1/2 x 16-1/2 inches, except for the 594 Class (8 inches in diameter) and the 598 Class (7-1/2 x 12 inches). The very oldest SSNs (578 and 585 Classes) have fairleads of insufficient strength for towing. For these submarines the towing pendant will either have to be centered laterally by using the mooring cleats, or as an alternative, a tow connection will have to be made. For all other submarines, the fairlead can and should be used. The smaller fairleads must be carefully checked to confirm that the towing appendages and the chafing chain will pass through the small dimensions provided.

   2 Most of the non-688/21/726 Class submarines carry designated towing gear onboard. This gear includes shackles, a pelican hook and a wire chafing pendant of 1-inch diameter or larger (Figure 582-7-4). The proof test of the rig is 80,000 lbs.

CAUTION

This towing rig is intended for emergency towing. The shackles shown in the submarine towing plans are 1-3/4 inch screwpin anchor shackles and should not used unless the pins are moused. Safety shackles are the preferred shackles to be used for emergency towing. The standard tow pad will accept the pin of a standard 2-inch safety shackle. The towing ship should substitute appropriate safety shackles with the required bolt-locking fitting.

Table 582-7-1 SUBMARINE TOWING EQUIPMENT

	Tow Hawser	Tow Pad or cleat strength (pounds)	Pendant or bridle length (feet)	Remarks
Ship class displacement	a. Type b. Diameter or circumference (in.) c. Length (ft) d. Breaking Str. (lbs.)			
SSN 585 SKIPJACK Class 3500 tons	a. Synthetic b. 2-3/4 in. cir. c. See remarks d. 22,500 lbs	Pad-22,500 lbs	Pendant-10 ft. wire rope	Tow hawser not carried onboard
SSN 594 PERMIT Class 3800 tons	a. Nylon b. 3-3/4 in. cir. c. See remarks d. 42,000 lbs	Pad-42,000 lbs	None	Tow hawser not carried onboard
SSBN 616/ 640 LAFAYETTE Class 8300 tons	a. Wire rope b. 1-in. dia. c. See remarks d. 73,400 lbs	Pad-80,000 lbs	None	Tow hawser not carried onboard
SSBN 627 JAMES MADISON Class 7300 tons	a. Wire rope b. 1-in. dia. c. See remarks d. 73,400 lbs	Pad-80,000 lbs	None	Tow hawser not carried onboard
SSN 637 STURGEON Class 4000 tons	a. Wire rope b. 3/4-in dia. c. See remarks d. 41,800 lbs	Pad-80,000 lbs	None	Tow hawser not carried onboard
SSN 688 LOS ANGELES Class 6900 tons	a. Nylon b. 5-in cir. c. 450 ft d. 73,000 lbs	Cleat-70,000 lbs (strength of single cleat)	Bridle-15 ft Pendant-31 ft	Tow hawser is carried onboard submarine
SSBN 726 OHIO Class 18,700 tons	a. Nylon b. 8-1/2 in. cir. c. See remarks d. 218,000 lbs	Cleat-70,000 lbs (strength of single cleat)	Bridle 14-ft (2-in. dia.) wire rope	Tow hawser and tow gear not carried onboard

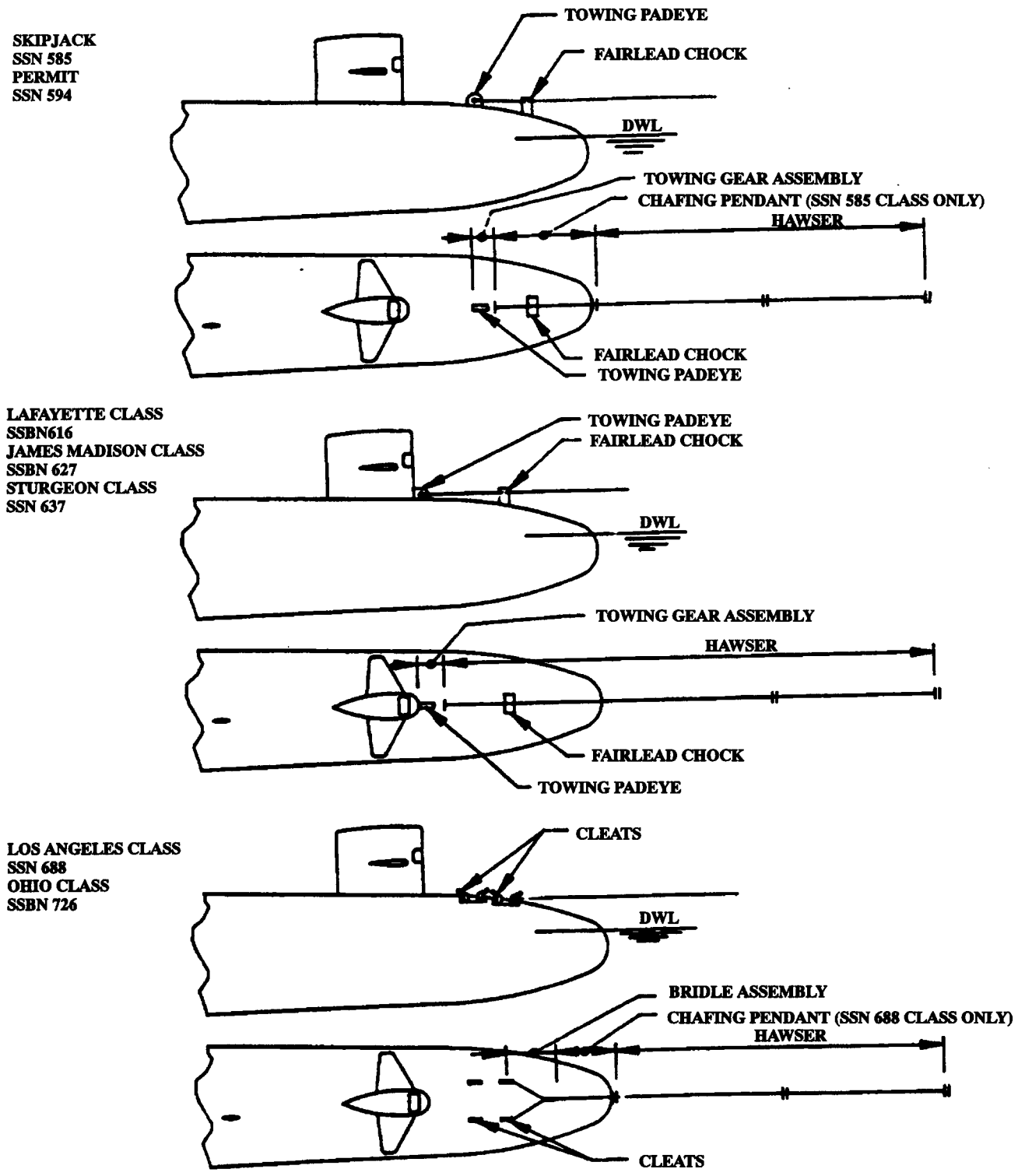


Figure 582-7-4 Submarine Towing Gear

CAUTION

The submarine's own towing rig may include a short wire chafing pendant. The pendant, however, may only be 3/4 inch or 1 inch and may provide inadequate chafing protection for a long distance, deep-catenary tow, especially in the fairlead chock. The towing ship should provide its own chafing pendant of sufficient length to make the final connection to the tow hawser on the fantail of the towing ship. The pendant should be made up to include a short length of chain to ride in the fairlead chock for chafing protection.

c. SSN 688 CLASS SUBMARINES

1 This submarine class has no tow pad or forward fairlead. It is designed to be towed by using a bridle attached to the forward pair of hinged mooring cleats. Each cleat has a safe working load of 70,000 lbs. Figure 582-1-3 shows a hinged cleat and Figure 582-7-5 shows a schematic of the towing rig carried onboard the SSN 688.

2 The bridle is made up of two 15- foot lengths of 1-3/8 inch, 6 x 37 galvanized IPS wire. The chafing pendant is a 31-foot length of 1-3/8 inch wire. The towing hawser is a 450-foot length of 5-inch circumference, double-braided nylon with a 5-1/2 inch rope coupling at each end.

CAUTION

Neither the pendant nor the hawser is recommended for ocean towing of this submarine except in an emergency. The towing ship should provide a 1-5/8 inch chafing pendant of sufficient length to make the hawser connection on its own fantail.

3 Use the 1-3/8 inch bridle provided for this submarine. The soft eyes in the end of the bridle legs must be appropriately lashed to ensure they do not jump off the cleats.

d. SSBN 726 CLASS SUBMARINES

1 These large submarines, like the SSN 688 Class, are towed with a bridle attached to the forwardmost pair of mooring bitts. The gear is more robust than for other submarines, but it is not carried on board the submarine.

2 The main ballast tank (MBT) vent covers for MBTs 1 and 2 must be installed prior to rigging the SSBN 726 Class for tow.

e. SSN 21 CLASS SUBMARINES

1 These large submarines have onboard an emergency towing pendant designed for emergency towing.

2 The emergency towing pendant assembly consists of a towing padeye, towing chock, chafing chain, wire rope and sockets, and two North Atlantic Treaty Organization (NATO) standard links. An intermediate fitting in the towing pendant is four feet above the hull on the port side of the sail at frame 24 where the pendant is stowed and faired to the sail. This fitting, consisting of a NATO standard link, allows a towing line to be attached. The entire towing assembly is normally not visible. It is stowed in a trough, covered with Neat Dura-1 material and faired to the hull and sail. See Figure 582-7-6 for emergency towing pendant assembly details.

3 Under certain conditions, the ship may be towed using a bridle attached to the forward pair of hinged mooring cleats. Each cleat has a safe working load of 70,000 pounds. The towing ship can easily make up its own bridle using appropriate lengths of at least 1 5/8–inch diameter wire, safety or plate shackles, and

a flounder plate. **The chafing pendant should be at least 1 5/8–inch wire, although heavier wire is preferred.** The pendant must be long enough to permit connection to the main tow hawser onboard the tow ship.

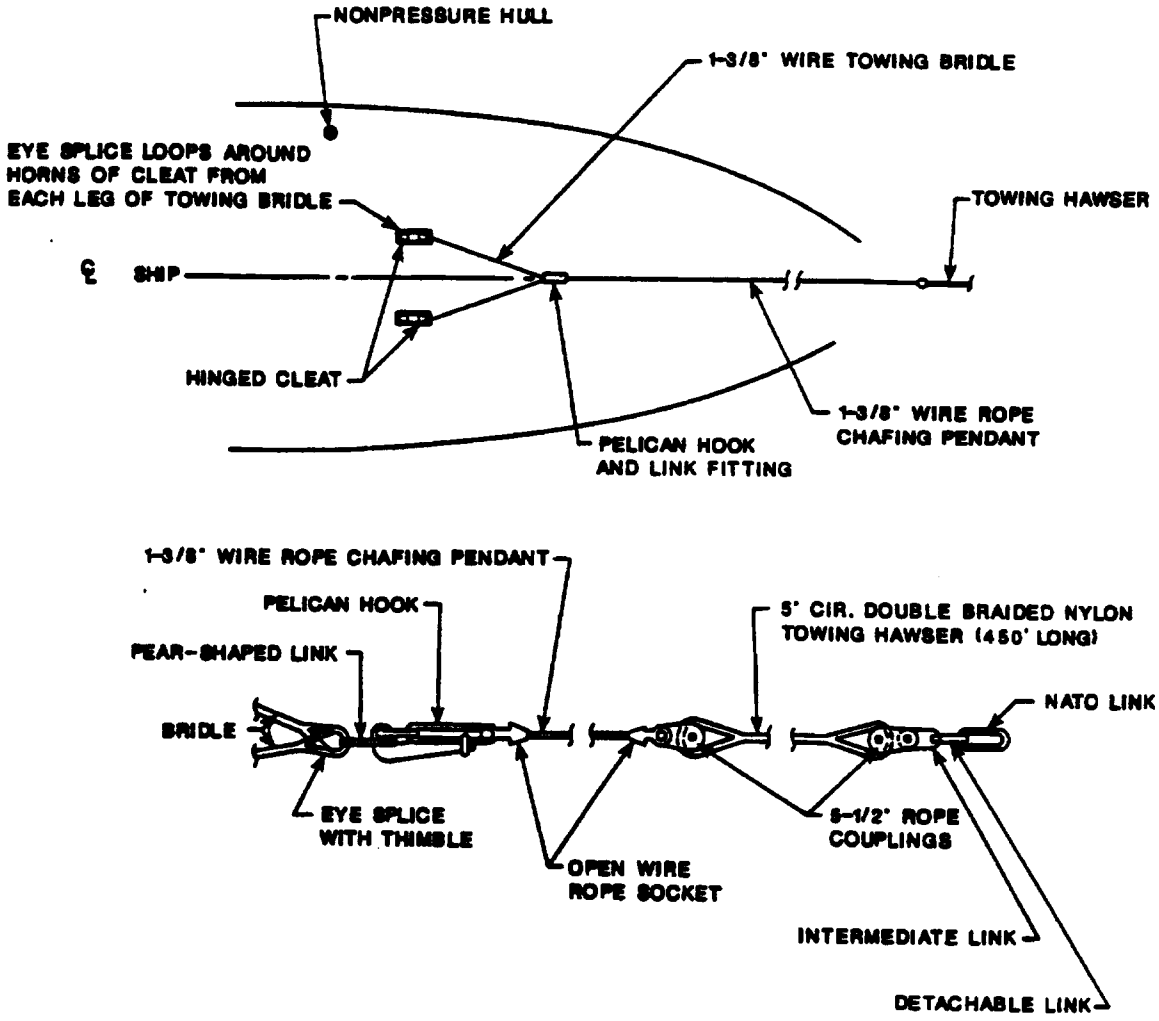


Figure 582-7-5 SSN 688 Towing Schematic

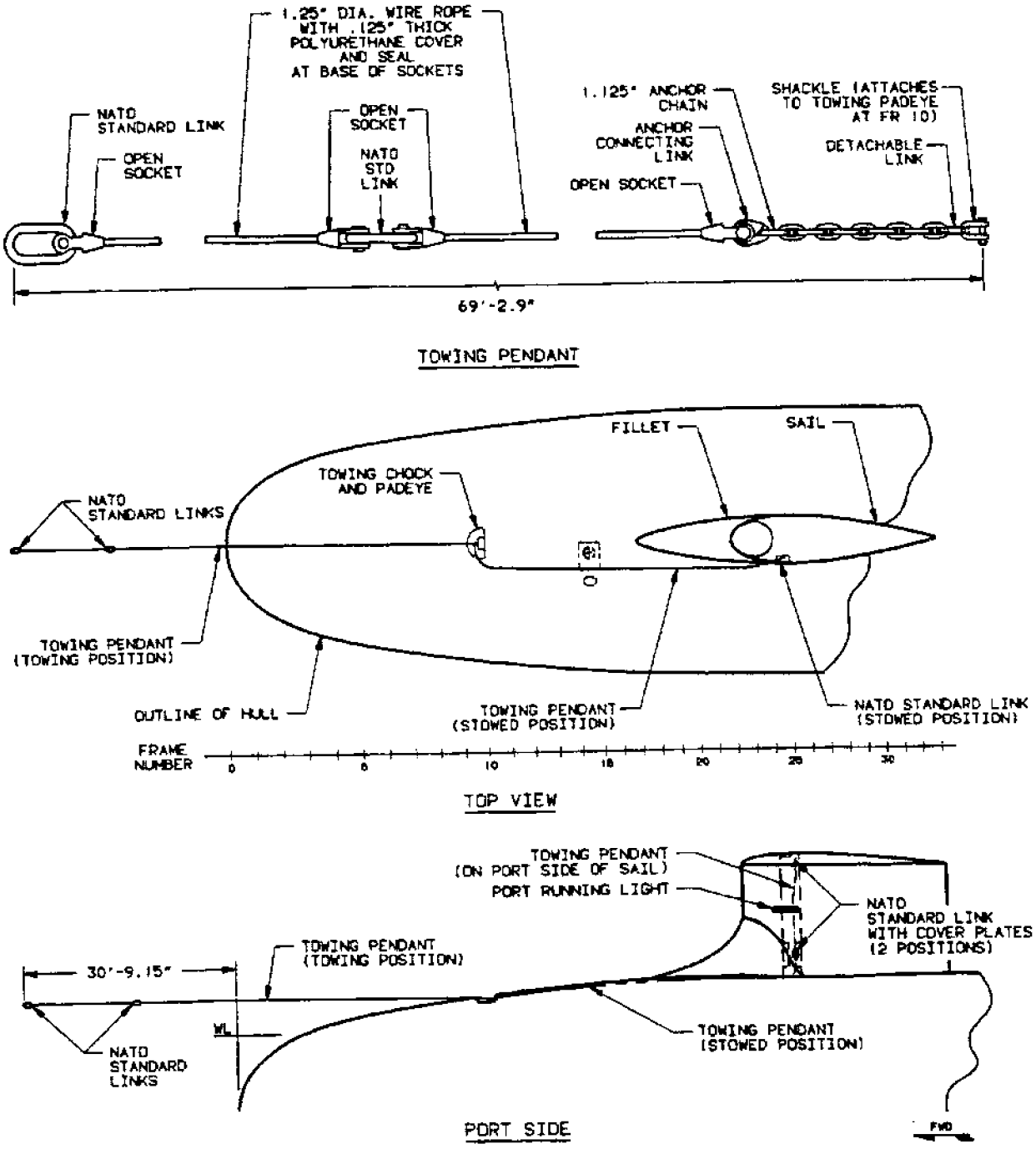


Figure 582-7-6 Emergency Towing Pendant Assembly

SECTION 8.
DESCRIPTION OF TOWING EQUIPMENT

582-8.1 TOWING COMPONENTS

582-8.1.1 OVERVIEW. The following paragraphs provide a brief description and discussion about the equipment used for towing:

NOTE

Towing fittings (all appendages) for mine sweepers shall be nonmagnetic.

582-8.1.2 TOWING PADEYE. A towing padeye is securely welded to the ship's main deck structure at the stern and serves as the attachment point for the towing hawser when the ship is towing. There are three types of towing padeyes commonly found on naval combatants: two vertical types (see Figure 582-8-1) and a horizontal type (see Figure 582-8-2).

582-8.1.3 CHOCK. When the ship is being towed, a bow chock (see Figure 582-7-2) sometimes called a bullnose, is used for the lead of the towing gear. A stern chock (see Figure 582-7-1), usually located on the centerline, is used when towing another ship.

582-8.1.4 TOWING HAWSER. The towing hawser is the primary load-carrying element of the tow line. It is usually made from galvanized wire rope or synthetic fiber rope such as nylon or polyester. Twelve-strand, plaited or double-braided polyester, in accordance with MIL-R-24750, MIL-R-24730 or MIL-R-24677, respectively, are currently the recommended types of rope to be used for new construction ships equipped with synthetic fiber rope towing hawsers. The synthetic fiber rope hawsers are usually 100 fathoms (600 feet) long with eye splices at each end. The final length of new, assembled towing hawsers, bearing point-to-bearing point (relaxed), is dependent on the length ordered minus the lengths required for the eye splices on each end. In no instance should towing hawsers, new or respliced, be less than 550 feet for nominal 600-foot hawsers. The wire rope towing hawsers found on aircraft carriers are 150 fathoms (900 feet) long and are made from 6 x 37 galvanized wire rope cable with eye splices and solid thimbles at each end.

582-8.1.4.1 Towing thimbles are fitted in the eye splices at each end for attaching the hawser to the towed ship's towing hawser or anchor chain at one end and the chafing chain of the towing ship at the other end.

582-8.1.4.2 There are various types of end fittings. The types that are normally used as part of the towing hawser are shown in Figure 582-8-3, Figure 582-8-4 and Figure 582-8-5.

582-8.1.4.3 Observing the catenary is the most practical way to determine when the tension in a synthetic hawser is approaching the danger point. Optionally, a tattletale may be used. Refer to **NSTM Chapter 613, Wire and Fiber Rope and Rigging** and paragraph 582-3.1.3.1 for a description of how to rig a tattletale.

582-8.1.5 END FITTINGS FOR TOWING HAWSERS. The recommended end fittings for towing hawsers made of synthetic rope (nylon and polyester) are:

a. Towing thimble (NAVSEA Dwg No. 803-6397321) shown in Figure 582-8-4.

b. Rope connector shown in Figure 582-8-5 (commercially available).

c. Thimble and link (NAVSEA sketch No. 56W41-14A) shown in Figure 582-8-6

d. Rope coupling (NAVSEA Dwg No. 803-5000916) shown in Figure 582-8-3

Figure 582-8-1 Vertical Towing Padeye

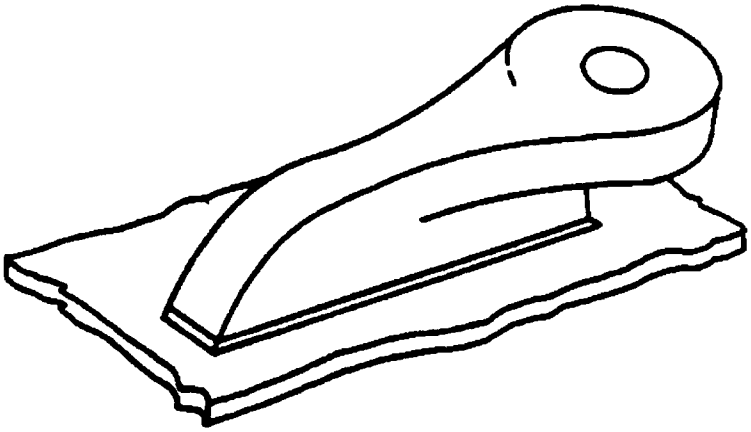


Figure 582-8-2 Horizontal Towing Padeye

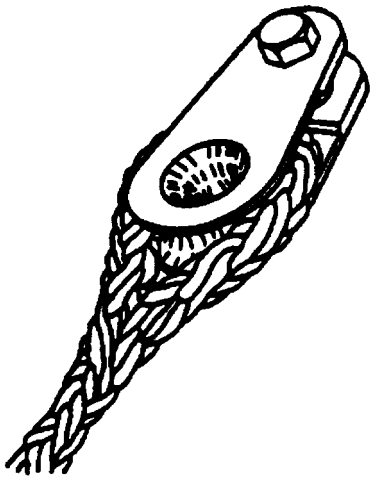


Figure 582-8-3 Rope Coupling

Figure 582-8-4 Towing Thimble

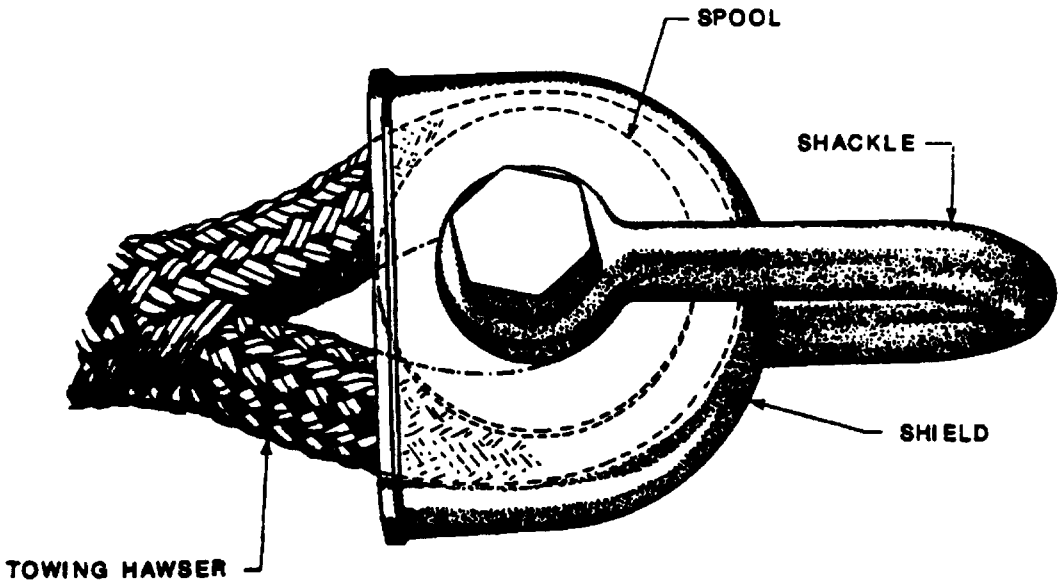


Figure 582-8-5 Rope Connector

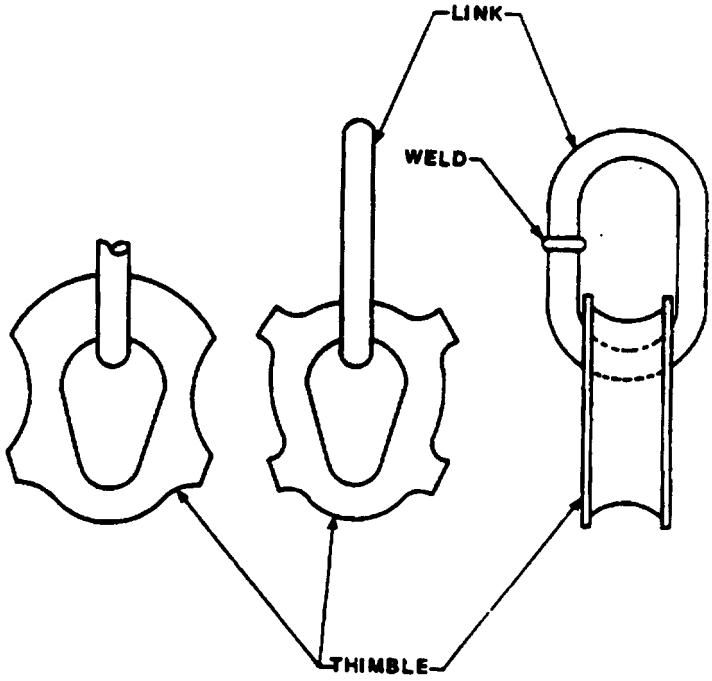


Figure 582-8-6 Thimble and Link

The manufacturing requirements for the thimble and link assembly are shown on NAVSEA sketch No. 56W41-14A. Newco thimbles (Figure 582-8-7) should be replaced with the above approved fittings at the earliest availability. Boston thimbles are similar to towing thimbles (Figure 582-8-4) except they are made of aluminum bronze alloy. The Boston thimbles should also be replaced with the recommended fittings whenever convenient.

582-8.1.6 CHAFING CHAIN. A chafing chain is a length of chain lead from the towing hawser to the attach-

ment point (padeye) on the towing ship (see Figure 582-6-1). For a towed ship, the anchor chain serves as the chafing chain and is usually lead out through the bow chock and attached to the towing hawser. The length of chain lead out from the bow ranges from five to 45 fathoms (30 to 270 feet). Chain is used primarily to provide a catenary to the towing hawser for keeping the ships in step and to withstand chafing.

582-8.1.7 CONNECTING APPENDAGES. Connecting appendage items include shackles, detachable links, end links, as well as specially sized and arranged lengths of chain. This hardware is used to connect the various long, flexible portions of the tow line system to each other and to the tow. Figure 582-6-2 shows a chafing chain and some of the connecting appendages.

582-8.1.8 NATO TOWING LINK. A NATO towing link is a special link to facilitate connection of the towing rig with ships of other nations. Figure 582-8-8 shows a NATO towing link. The details of the NATO towing link are shown on NAVSEA standard Dwg No. 803-5959315. The towing ship passes its NATO link to the towed ship. The NATO towing link should be available to the fleet by September 1991 from SPCC, Mechanicsburg, PA.

CAUTION

The U.S. Navy NATO standard towing link has a breaking strength of 700,000 pounds. The breaking strength of the towing links provided by other member nations is their responsibility and may be of greater or lesser strength than the U.S. Navy NATO towing link.

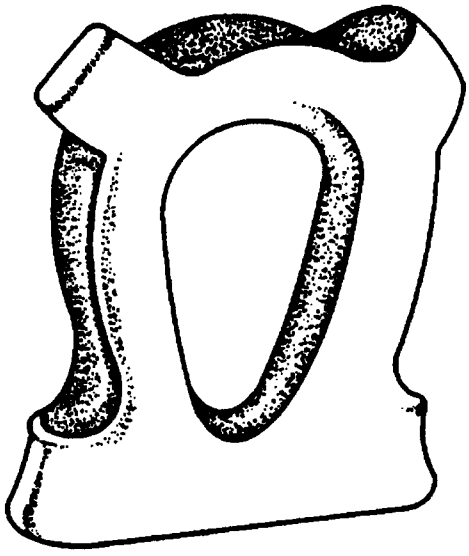


Figure 582-8-7 Newco Thimble

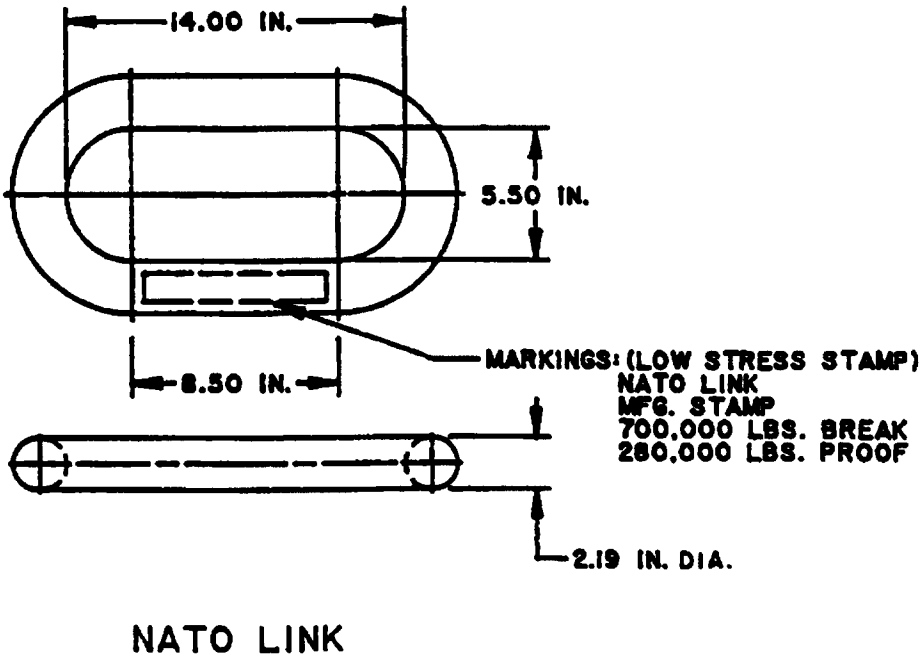


Figure 582-8-8 NATO Towing Link

582-8.1.9 CHAIN STOPPERS. Chain stoppers are used in groups of two or more to secure the ship's anchor chain. They relieve the strain on a windlass caused by towing loads. The Navy uses the pelican hook chain stopper. The pelican hook has a strong back and bill that is passed on a link of chain and held in place with a bail and pin. Typically, the pelican hook is connected to a turnbuckle by a detachable link. The pelican hook is used if the tow must be dropped in an emergency. Another detachable link connects the other end of the turnbuckle to a shackle that attaches to a padeye welded to the deck. Towing chain stoppers are the same as housing chain stoppers, except that they have modified eyebolts that accept a locking plate and cotter pin. These locking plates prevent the chain stopper turnbuckle from backing off when subjected to the shock loading of the towing hawser. Figure 582-8-9 shows a pelican hook chain stopper. No turnbuckle is used on the pelican hook aft.

582-8.1.10 SPRING-LAY ROPE 6X3X19. This type of rope is used in harbor towing by service craft. This type of wire rope is more flexible than wire rope, but not as strong. It is stronger than fiber rope of the same diameter. It is made of six (3x19) main strands laid around a fiber core. Each main strand consists of three fiber strands and three preformed steel wire strands of 19 wires each, laid alternately around a fiber center. The fiber portion provides a cushion for the wire strands and results in a rope having good flexibility and elasticity.

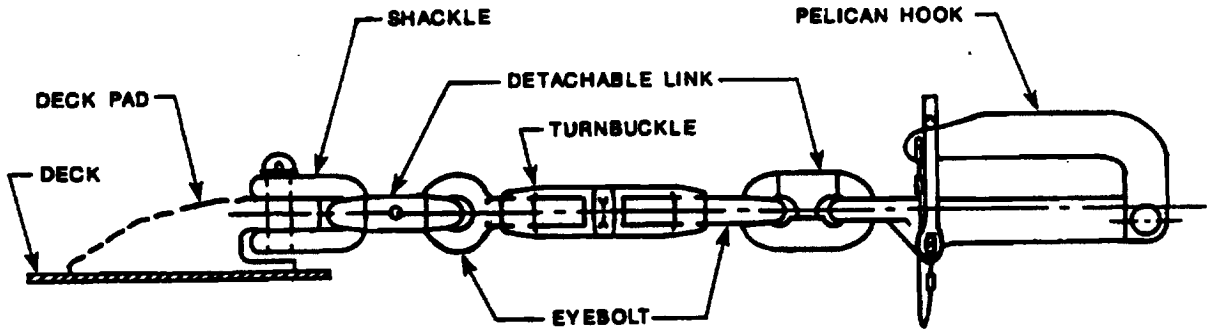


Figure 582-8-9 Pelican Hook Chain Stopper

SECTION 9.

TOWING SAFETY PRECAUTIONS

582-9.1 CHECKLIST FOR PREPARING AND RIGGING A TOW UNDER EMERGENCY CONDITIONS

582-9.1.1 GENERAL. The circumstances under which a ship may have to take another ship in tow are so varied that no definite rules can be set down. In view of this, it is important that officers and deck petty officers be well-indoctrinated in this phase of seamanship.

582-9.1.2 INSTRUCTIONS AND PUBLICATIONS ABOUT EMERGENCY TOWING. There are several instructions and publications that discuss towing and salvage operations which may be used to provide information and training for personnel involved with emergency towing. These documents include: COMNAVSURFLANT Instruction 4740.1 C, COMNAVSURFPAC Instruction 4740.3C, Military Sealift Command Instruction 4740.1C, and ATP43, a NATO unclassified publication for ship-to-ship towing.

582-9.1.3 TOWING JURY RIGS. If the ship-to-be-towed normal towing arrangements are not available, a jury rig will have to be used. Examples of typical towing jury rigs can be found in ATP43.

582-9.1.4 TOWING CASUALTY REPORT. A casualty report of the ship-to-be-towed should be made as soon as possible and reported to the ship making the tow. This report should include all relevant information on the conduct of the tow. The state of the following items should be included:

a. The propulsion system, including whether propellers are locked or unlocked, and if power is available to the anchor windlass.

b. Hull condition, including any weakened bulkheads or holes in the skin of the ship.

c. Condition of the steering gear; that is, operable or inoperable.

d. Condition of deck machinery, including capstans, windlasses and winches, that is, operable or inoperable.

e. Available towing equipment.

f. Crew condition regarding rigging for a tow and breaking out necessary equipment.

g. Will the crew remain aboard the towed vessel?

h. Communications between ships when making up the tow and during the tow.

i. General trim of tow.

j. Will towed ship be in or require ballast?

k. What type of ballast?

l. Record drafts after the towed ship is in proper trim; fwd ____ and aft ____.

m. Are all sea valves closed and wired shut?

n. Are all bilges free of oil and water?

o. Is hull damage and/or flooding under control?

p. Closely inspect all below decks drain piping which originates above the waterline and terminates below the waterline. Check for loose connections or rusted out places in the piping.

NOTE

For a ship or craft to be in proper trim for towing, it should draw, for each 100 feet of length, approximately one foot more water aft than it does forward. Deep draft tows use somewhat less than one foot for each 100 feet. Before trimming excessively, ensure that drafts obtained will allow sufficient clearing of the bottom at point of departure, transit, and point of delivery; and that stability of tow is not impaired.

q. The rudder(s) should be centered and locked by using a minimum of a four-inch angle iron from the ship's structural strong points to the rudder yoke, welded into place.

r. For LST-type tows the following questions must have affirmative answers:

1 Do the bow doors have hydraulic rams connected?

2 Are mud flaps at the bottom of the doors secured?

3 Are all dogs, heavy-weather shackle ratchet-type turnbuckles and strongbacks in place, tight and secure so that they cannot work free?

4 Are bow ramp operating instructions posted in the hydraulic control room?

s. Are amber colored flooding alarm lights installed on the towed ship? This is desirable if the towed ship is unmanned and flooding is a possibility.

t. Are navigation lights installed for the towed ship?

u. If towing pads do not exist, bitts or cleats can be used but should be checked for handling the strain of towing.

v. If bitts are used as bridle attachment points, the chain or wire should be figure-eighted with four or more figure-eights. Heavy channel iron must be welded across the bitts to prevent the chain from jumping out.

w. Submarine tows:

1 For most submarines it is not possible to use their anchor chain or fairleads for towing or for personnel to work with towing equipment on the submarine's open deck while it is at sea. It may be necessary for the towing ship to provide the towing rig and, in some cases, to connect its hawser to the submarine's equipment, which may be a special chain cable, wire rope pendant or short synthetic towing hawser.

2 When towing a submarine the diving planes should be set at an angle of 20 to 25 degrees with their trailing edges up.

582-9.2 SAFETY PRECAUTIONS

582-9.2.1 TOWING SAFETY PRECAUTIONS. The following safety precautions are basic and should always be followed during towing operations:

a. During heavy weather life jackets will be worn by all personnel topside.

b. Personnel involved in rigging and unrigging towing gear and handling lines shall wear lifejackets, safety helmets and safety shoes. Personnel handling messengers and synthetic tow lines may wear gloves. Personnel handling wire rope shall wear gloves. Rings, loose clothing, etc., should not be worn.

c. Be careful when handling towing hawsers and observe the precautions for using synthetic fiber ropes as stated in using synthetic fiber ropes as stated in **NSTM Chapter 613, Wire and Fiber Rope and Rigging** . A training video, available from the Naval and Education and Training Support Centers, titled ″Synthetic Line Snapback″ Order No. 82971 DN1982, shows the hazards associated with synthetic towlines.

d. When rope is used in towing operations without a towing engine, the towing hawser must have a scope of at least 200 fathoms (1200 feet) especially for long tows and in heavy weather. However, the urgency of the situation or navigational hazards may dictate the use of a single hawser rig, (100 fathoms [600 feet]), even in heavy weather, in order to get the tow under way. A second hawser can be added when conditions permit.

e. Never let the hawser be sprung so much that it straightens out clear of the water or be allowed to drag on the bottom.

f. Inspect the towing hawsers thoroughly during overhaul periods. Replace the hawsers if inspection reveals any unsatisfactory conditions.

g. Take the following precautions before disconnecting the anchor chain on the forecastle for towing and rousing out the anchor chain:

   1 Use a wire rope preventer of adequate size to support the weight of the anchor, to back the housing stopper and to prevent the accidental dropping of the anchor.

   2 Use a preventer, if available, otherwise insert a steel bar through a link across the upper lip of the chain pipe or lash with rope.

h. Make provisions for emergency release of the tow line. (An axe, large bolt cutters, cutting torch, release stopper or pelican hook may be used).

CAUTION

Make sure the wildcat is engaged and the steel bar is removed before operating the wildcat.

i. When getting underway, build up turns slowly; never go from dead-in-the water to standard speed.

j. Ensure that the tow line and the appendages are in good condition. Never use a hawser that is kinked. See **NSTM Chapter 613, Wire and Fiber Rope and Rigging** , Section 2, on the care of synthetic fiber rope hawsers, especially what to do with a hawser that has a severe kink or cockle.

k. If the tow is sinking, disconnect the tow line immediately.

l. Unless sinking of the tow appears imminent, do not abandon the tow. It is the towing ship’s duty and responsibility to prevent the loss of the tow.

m. During favorable weather and seas, ensure that a sufficient catenary exists to absorb shock loading. Never tow at short stay in rough weather.

n. Ensure that all rigging is adequate. If questionable, always overrig.

o. Keep a lookout for small weather fronts. A sudden unexpected weather front can cause great damage.

p. Keep all unnecessary personnel away from the vicinity of the tow line.

q. Set a towing watch on both ships.

r. If the towing ship loses power, the course of the towing ship should be altered immediately to prevent being overrun by the towed ship.

582-9.3 EMERGENCY TOWING BILL

582-9.3.1 SHIP'S EMERGENCY TOWING BILL. OPNAVINST 3120.32 B (section 630.22) sets forth policies for assigning personnel to stations and duties in order to provide a basic organization when the ship is towing or being towed. Each ship is required to develop an emergency towing bill which sets forth detailed towing procedures and responsibilities. The procedures should reflect the actual towing gear on the ship and how it should be rigged when the ship is towing and when it is being towed. The personnel responsibilities list identifies the respective unit personnel and their duties when making up a tow. The weapons/deck officer is responsible for the bill. Example of tow line rigging procedures, communications during towing operations, towing personnel assignments, safety precautions, and equipment for towing operations, are listed in various sections of this chapter and can be used for guidance when preparing the ship's emergency towing bill.

582-9.4 EXAMPLE OF EMERGENCY TOWING DETAIL PERSONNEL ASSIGNMENTS

582-9.4.1 RESPONSIBILITIES OF PERSONNEL DURING AN EMERGENCY TOW. Table 582-9-1 shows a typical list of personnel assignments that are used during an emergency towing operation.

582-9.5 EXAMPLES OF TOWING EQUIPMENT

582-9.5.1 SAMPLE LIST OF EQUIPMENT REQUIRED FOR TOWING. See Table 582-9-2 for a typical list of equipment used by the towing ship.

582-9.5.2 SAMPLE LIST OF EQUIPMENT REQUIRED WHEN BEING TOWED. See Table 582-9-3 for a typical list of equipment used by the towed ship.

582-9.6 COMMUNICATIONS BETWEEN SHIPS DURING TOWING OPERATIONS

582-9.6.1 TOWING SIGNALS. When towing, a means of communicating between the towing ship and the tow is essential. The best way of communicating usually is by radio or electric-powered megaphones (bull horns). When radio or bull horns are not available, flaghoists can be used. A faster means is by sound signals which also may be used to supplement any other means. Table 582-9-4 lists the sound signals used by the Navy during towing operations.

582-9.6.2 FLAG SIGNALS. Flag signals may be obtained from ATP1, volume 11 (for Naval ships), or HO 102 (for merchantmen).

Table 582-9-1 EXAMPLE OF PERSONEL ASSIGNMENTS DURING AN EMERGENCY TOW

Title	Number Assigned	Responsibility
Safety officer	(1)	Ensure towing evolution is conducted safely.
BMC/BM1	(1)	In charge of rigging and passing of towing hawser. Reports to the First Lieutenant.
BM2/BM3	(1)	In charge of line handlers
BM3	(1)	Signalman STA/STA

Table 582-9-1 EXAMPLE OF PERSONEL ASSIGNMENTS DURING AN EMERGENCY TOW - Continued

Title	Number Assigned	Responsibility
SN/SA	(1)	(1JV) Phone talker STA/Bridge
SN/SA	(6)	Towing hawser and messenger line handlers
PO (Eng)	(1)	Capstan operator
PO (Eng)	(1)	Cutting outfit
PO (Gunnery)	(1)	Line throwing gun
PO (HM)	(1)	First aid kit
NOTES: (1) Special sea detail is set on the bridge, in main control and after steering. (2) Line handlers will serve as towing watch, as assigned. (3) Both ships are to provide their own towing hawser. (4) Anchor detail is set, as required. (5) Assign personnel to cut the stops on the towing hawser, as required.		

Table 582-9-2 EXAMPLE OF TYPICAL EQUIPMENT USED BY THE TOWING SHIP

Quantity	Item
1	Pelican hook and shackle
1	Chafing chain (3 to 5 fathoms [18 to 30 ft]) with long link detachable links, as required
1	Deshackling kit
1	600-ft tow hawser (with end fittings) and NATO link (see paragraph 582-8.1.8 for a description and availability of the NATO towing link)
1 Messenger: 3 ea	6-thread or 9-thread manila line 100 fathoms (600 ft)
1 ea	1-1/2 inch circumference synthetic fiber line 50 fathoms (300 ft)
1 ea	3-inch circumference synthetic fiber line 100 fathoms (600 ft) (Use 4-inch circumference synthetic fiber line for 10-inch circumference and larger towing hawser.)
1	4x4 shoring timber
1	3/4-inch dia. wire rope pendant (jackstay) 21-thread stops (as required)
1	Sledge hammer
1	Fire axe
1	Tool kit
1	Retrieving line (as required)
1	Line throwing gun/bolos
2	Heaving lines
1	Signal light/paddle

Table 582-9-3 TYPICAL LIST EQUIPMENT USED BY THE TOWED SHIP

Quantity	Item
1	Anchor chain
2	Chain stoppers (with locking plates)
1	Deshackling kit

Table 582-9-3 TYPICAL LIST EQUIPMENT USED BY THE TOWED SHIP - Continued

Quantity	Item
4	Chain hooks
1	Cable jack
1	Detachable link (spare)
1	600-ft tow hawser (with end fittings) and NATO link
1 Messenger:	50 fathoms (300 ft) of 1-1/2 inch circumference line (synthetic fiber) 100 fathoms (600 ft) of 3-inch circumference line (synthetic fiber)(Use 4-inch circumference line for 10-inch circumference and larger towing hawsers.)
1	4x4 shoring timber
1	3/4-inch dia. wire rope pendant (jackstay) 21-thread stops (as required)
1	Sledge hammer
1	Fire axe
1	Tool kit
1	Chain bar
1	Retrieving line (as required)
1	Cutting outfit
2	Heaving lines
1	Line throwing gun/bolos
1	Signal light/paddle

Table 582-9-4 NAVY TOWING SOUND SIGNALS

Meaning	Signal
I am putting my rudder right	1 short blast
I am putting my rudder left	2 short blasts
Haul away	2 short, 1 prolonged blast
Let go	2 prolonged, 5 short blasts
Go ahead	2 prolonged blasts
Pay out more line	1 short, 2 prolonged blasts
Stop	1 prolonged, 2 short blasts
Avast hauling	3 short blasts
All fast	2 prolonged, 1 short blast
I am letting go	3 groups of 5 short blasts

SECTION 10.

MAINTENANCE AND INSPECTION OF TOW LINE COMPONENTS

582-10.1 MAINTENANCE OF TOWING EQUIPMENT

582-10.1.1 MAINTENANCE REQUIREMENTS. Follow the Planned Maintenance System (PMS) requirements in accordance with instructions provided on applicable Maintenance Requirement Cards (MRCs). If not available, perform the following:

582-10.2 INSPECTION OF TOWING EQUIPMENT

582-10.2.1 INSPECTION INTERVALS. The towing rig should be inspected before and after each use. If doubt exists of the reliability, replace the tow line components.

582-10.2.2 INSPECTION PROCEDURES. The following inspection procedures for the various components of a towing rig are from a typical MRC:

1. Inspect towing pad, chafing chain, shackles and towing hawser thimble and couplings for cracks, corrosion, distortion and uneven wear.
2. Inspect applicable towing gear accessories, such as retrieving lines, tackles, blocks, chain, pendants, preventers and grapnel hooks for deterioration, distortion, loose whippings, corrosion and evidence of wear.
3. Lay out towing hawser and messenger; inspect for chafing, cuts, rust damage, cockling and uneven wear.
4. Inspect stopper assembly and pelican hooks for cracks and distortion.
   a Clean threaded and exposed working surfaces.
   b Apply a light coat of grease, MIL-G-23549, to the threaded working surfaces.
   c Apply oil to working surfaces not accessible for grease application.
5. Spread canvas tarpaulins in work areas.
6. Disassemble detachable link(s).

CAUTION

Detachable link parts are not interchangeable. Keep each link's parts together and separate from the others.

a Clean C-shaped link, coupling plate, taper pin and lead plug with a wire brush dampened in solvent. Inspect for corrosion, cracks, distortion and uneven wear.

b Apply a medium coat of white lead and tallow to the detachable link interior surfaces.

c Reassemble detachable link.

7. Repeat step 6. for each of the remaining detachable links.

582-10.2.3 INSPECTION OF WIRE ROPE BRIDLES. If wire rope bridles are used in the towing rig assembly, conduct the following inspections:

NOTE

Wear gloves when handling wire rope

1. Flush wire rope that has been immersed in seawater with freshwater.
2. Clean wire rope bridles with a wire brush, cleaning solvent and rags.

3. Inspect wire rope for corrosion and broken wires.
4. Measure wire rope diameter at six or more places with vernier calipers. (Figure 582-10-1 shows how to correctly measure the wire rope diameter.)
5. Count the number of broken wires in each lay length and each strand lay length.
6. Inspect the wire rope and replace when one or more of the following conditions exist:
   a Evidence of pitting due to corrosion.
   b Nominal diameter is reduced by more than the amount shown in Table 613-1 of **NSTM Chapter 613, Wire and Fiber Rope and Rigging** . (Nominal diameter is the new wire rope diameter.)
   c Wear of 1/3 of the original diameter of the outside individual wires.
   d Six broken wires in one rope lay length, or three broken wires in one strand lay length.
   e One broken wire within one rope lay length of any end fitting.
   f Kinking, crushing, birdcaging or any other evidence of damage resulting in distortion of the rope structure.
7. Clean and inspect the following wire rope end fittings for cracks, deformity and tightness of fit, as applicable:
   a Poured sockets -- inspect for deterioration of zinc.
   b Fiege fittings -- determine that wires are visible through inspection hole.
   c Swage fittings -- inspect for deterioration, cracks, evidence of wear and looseness.
8. Apply a medium coat of grease, MIL-G-18458, to clean portion of wire rope.
9. Remove excess lubricant.
10. Touch up chafing chain, shackles and stopper assembly with paint.
11. Allow all parts to air dry, tag for identification and restow.

582-10.2.4 STORAGE OF SYNTHETIC ROPE TOWING HAWSER. The synthetic towing hawser should not be stowed where it will be exposed to direct sunlight or where it can contact bare iron surfaces.

582-10.3 STORAGE AND CARE OF FIBER AND WIRE ROPE TOWING HAWSERS

582-10.3.1 REQUIREMENTS FOR CARE OF FIBER AND WIRE ROPE TOWING HAWSERS. See **NSTM Chapter 613, Wire and Fiber Rope and Rigging** , Sections 1 and 2, for the care, storage and preservation of wire rope and fiber rope.

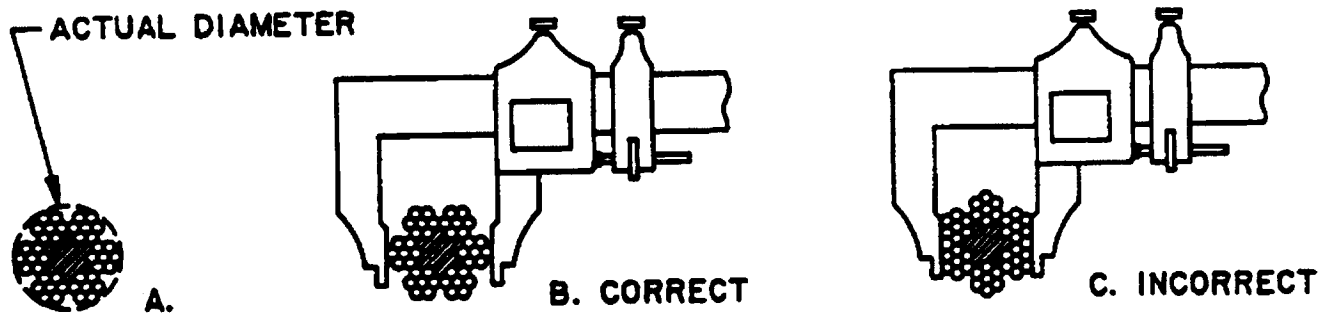


Figure 582-10-1 Wire Rope Measurement

SECTION 11.
HARBOR TOWING

582-11.1 TOWING ALONGSIDE

582-11.1.1 GENERAL. Harbor towing is done by harbor tugs when moving ships, barges or other nonpropelled craft within the confines of a harbor. Navy harbor tugs (YTBs) are equipped with a synthetic towing hawser for single tows. However, most towing done by these harbor tugs is for short distances and on protected waters so they use the alongside or ″towing on the hip″ method. Towing alongside offers excellent control over the towed ship or barge making it easier to maneuver in congested harbors. At least two or more harbor tugs are used for moving ships. When a submarine is towed using the alongside towing method, the tug's lines are secured to the deck cleats on the submarine.

582-11.1.2 LINES FOR TOWING ALONGSIDE. At least three lines are used when towing alongside:

a. A bow line

b. A power line or tow line located amidships on the tug

c. A stern line.

582-11.1.3 TYPES OF LINES USED FOR TOWING ALONGSIDE. Synthetic lines of nylon, polyester or spring-lay wire ropes are used for towing alongside. Do not mix the lines. For example, if a spring-lay wire rope is used for the tow line, also use spring-lay wire rope for the bow and stern lines.

582-11.1.4 RIGGING FOR TOWING ALONGSIDE. When the tug is alongside the ship or barge to be towed the lines are passed to the tow. Sometimes a messenger line is used to pass the lines from the tug to the tow.

582-11.1.4.1 Line passing sequence:

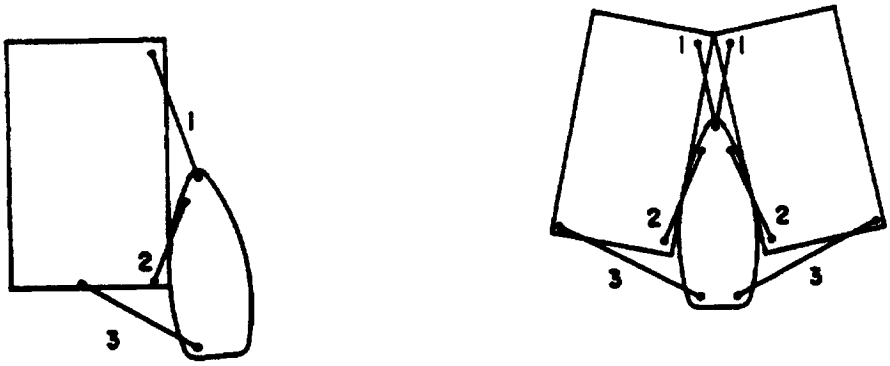
1. The tow line is passed first
2. Then the bow line or head line
3. Then the stern line or stern breast line.

582-11.1.4.2 The lines are then secured to H bitts at the bow and the stern of the tug. Bow and stern capstans on the tug then take a strain on the lines and keep them taut during the operation. Figure 582-11-1 shows a typical towing alongside rig.

582-11.1.4.3 Round Turns - Rope strength is best preserved on H bitts by use of round turns (Figure 582-11-2). When round turns are properly used with no half hitch, the rope will retain 90 percent of its strength. When half hitches are applied for snubbing the load, effective rope strength is reduced by 40 percent because half hitches just as knots) cause shearing of the rope.

582-11.1.5 CASTING OFF THE TOW LINES. The lines are removed in reverse order after the tow has been moved to its destination. The stern line is cast off the tow first, followed by the bow line, and last, the tow line.

582-11.1.6 CONDITIONS TO BE OBSERVED WHEN TOWING ALONGSIDE. Local weather conditions, maneuvering space, wind direction, current forces and tides should all be considered when making up an alongside tow.



1. BOW OR BACKING LINE
2. TOWING LINE (POWER)
3. STERN BREAST OR TURNING LINE

Figure 582-11-1 Towing Alongside

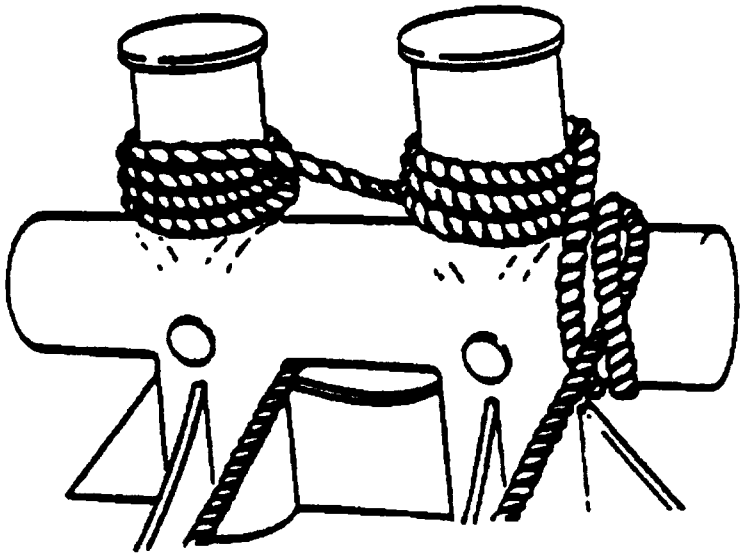


Figure 582-11-2 Correct Method of Securing on H Bitts (rounds turns)

582-11.2 SHIP MANEUVERING WITH TUGS

582-11.2.1 TUG ASSISTANCE DURING MOORING. Tugs are also used, without tow lines, to maneuver ships to and from berths. They push a ship into a berth or move it away from a berth by moving between the dock and the ship's hull and pushing it away from the dock.

582-11.2.2 REFERENCE SOURCES FOR ADDITIONAL INFORMATION ON TUG OPERATIONS. **Knight's Modern Seamanship** , **Boatswain's Mate 3 & 2** , and **Boatswain's Mate 1 & C** training manuals are excellent references that can be consulted for information on shiphandling with tugs and other towing situations that involve tugs.

SECTION 12.

TOWING IN ICE

582-12.1 ARCTIC TOWING

582-12.1.1 In arctic operations it may be necessary to tow a damaged ship or expedite the movement of another ship through heavy or broken ice. For more information on towing in ice, consult the **U.S. Navy Towing Manual** , SL740-AA-MAN-010.

582-12.2 SHIPS FOR TOWING IN ICE

582-12.2.1 An icebreaker is best suited for towing in ice because it is capable of breaking a channel in the heavy ice and has a reinforced hull to withstand the forces of the ice. Navy ocean tugs can also tow in broken ice but are not well suited for towing in heavy ice. In a convoy with only one icebreaker, other ships in the convoy may be called upon to tow.

582-12.3 PROCEDURE FOR TOWING IN ICE

582-12.3.1 GENERAL. When towing in ice the tow should be close to the towing ship's stern to keep the ice passage ahead of the towed ship open. In ice conditions the tow catenary should be adjusted so that the hawser does not come in contact with the ice which will cause the hawser to wear and chafe. The saddle and short scope towing methods are best suited for towing in ice.

582-12.3.2 SADDLE METHOD FOR TOWING IN ICE. The saddle method can be used by icebreakers and tugs with reinforced sterns and towing machines. Be aware, however, that U.S. Coast Guard icebreakers equipped with towing machines and strengthened saddles are being decommissioned. A ship can be brought up and held firmly in the saddle by the towing machine. Sometimes it may be necessary for a ship without a saddle to tow by this method. If this is necessary, substantial fendering must be provided.

582-12.3.3 SADDLE TOWING STEPS. Some steps that should be used when towing in the saddle or a variation of the saddle method are:

a. Use chafing gear.

b. Attach the tow line to the towing bridle or to both anchor chains of the tow.

c. Put the towing machine in the automatic mode to prevent the tow line from parting if the ships pitch or surge.

d. Two mooring lines can be passed from the towing ship's quarter bitts to the forecastle bitts on the tow to keep the tow following the towing ship.

e. The tow's engines can be used. If the tow starts to jackknife, the engines should be slowed until it is following properly.

f. A fire hose should be kept ready at the saddle when using the tow's engines since friction may cause fires in the chafing material.

582-12.3.4 SHORT SCOPE TOWING IN ICE. The short scope method should be utilized by tugs and ships without stern saddles. Even for towing ships equipped with stern saddles, the saddle method may not be practical for towing a ship with a high or bulbous bow.

582-12.3.4.1 Short Scope Towing Steps. Some steps that should be used when towing at short scope are:

a. Use both anchor chains and a towing bridle to provide extra weight in the short scope.

b. Maintain a scope of 150 to 300 feet.

c. Use the towed ship's rudder, if possible, to keep the tow in the towing ship's wake.

d. Use the towed ship's propeller to provide extra kick to help augment the rudder's force.

e. If possible, back the propeller of the towed ship if the propeller wash from the towing ship does not keep the bow of the tow from riding up on the towing ship's stern.

582-12.4 CONVOY TOWING IN ICE

582-12.4.1 In a convoy with only a single icebreaker, one or more of the convoy ships may have to tow. While in ice, all ships should be prepared for towing and being towed. The time saved in rigging a tow reduces the chances of getting caught in the ice.

APPENDIX A

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APPENDIX B

GLOSSARY

582-B.1 LIST OF TERMS

Abrasion
The wear of wire or fiber rope caused by sliding friction over fixed surfaces.

Anchor windlass
Machine used to hoist and lower anchors.

Automatic tension towing machine
Winch-like machine which relieves tension on the tow line by automatically paying out and then reclaiming wire payed out when the tension is reduced. Found on fleet tugs and salvage ships.

Bail
The part of a pelican hook or chain stopper that holds the hook closed.

Barrel
The rotating drum of a capstan or winch.

Bird caging
The flaring out of wires in wire rope around the full diameter of a rope, with resulting kinks in the wires. This can occur when there is a sudden release of a heavy load on a wire rope.

Bitt
A pair of metal posts or barrels to which mooring or towing lines are made fast.

Bitter end
The last part of a rope or chain, in contrast to the middle part or bight.

Bollard
Single posts secured to a wharf or pier. Used for mooring vessels by means of lines extending from the vessel.

Bow line
The mooring line that runs through the bull nose or chock at or near the bow of the ship.

Breaking strength
Ultimate or actual: The load required to pull a wire, strand or rope to destruction. Aggregate: The sum of the individual breaking loads of all the wires in a strand or rope.

Breast line
A mooring line from ship to pier or ship to ship, perpendicular to the fore and aft axis or at right angle to the ship.

Bridle
A two-legged towing rig of wire or chain attached to towing pads or a set of bitts on the tow. At the apex is a flounder plate or ring, dependent upon whether a chain bridle is being used. The two legs and the imaginary line between the points of attachment should form an equilateral triangle.

Bullnose
A closed chock in the stem of a ship.

Bulwark
Section of a ship's side, continued above the main deck, as protection against heavy weather.

Capstan
A revolving device with a vertical axis, used for heaving in mooring lines.

Catenary
The curve of a rope suspended between two points.

Chafing chain
A length of chain used to reduce chafing or wearing.

Chain
A connected, flexible series of links, used for binding, connecting or other purposes.

Chain bridle
A chain used in a bridle rig.

Chain connecting link
See Detachable link or Pear-shaped detachable link.

Chain pendant
A piece of chain used as a strap, rigged between the tow and tow hawser or used to create a catenary.

Chain stopper
A device used to secure chain, thereby relieving the strain on the windlass. Also used for securing the anchor in the housed position in the hawser pipe.

Chamfer
A bevel, used to form a smoother surface.

Check
To slack slowly while keeping a strain on the line without parting the line.

Chock
A heavy smooth-surfaced fitting usually located near the edge of the weather deck through which wire ropes or fiber rope hawsers may be led.

Closed socket
A wire rope termination similar to a padeye or ring.

Cockle (Hockle)
Kinking of one or more strands of twisted fiber line, or of wires on a wire rope.

Core (wire rope)
The axial member of a wire rope about which the strands are laid. It may consist of a wire strand, wire rope, synthetic or natural fiber, or solid plastic.

Depth tow line
The distance from the water surface to the bottom of the catenary.

Deshackling (detachable tool) kit
Used for assembling and disassembling detachable links. Included in these sets are hammers, punches, lead pellets, spare taper pins and hair pins.

Detachable link
A joining link or chain link used to connect chain to anchors, chain or other pieces of mooring, towing or beach gear equipment.

Die-lock chain
Chain formed by forging.

DWL
Design waterline.

EIPS wire
Extra Improved Plow Steel wire.

Eye splice
A loop formed at the end of a rope by joining the end of the rope with the body of the rope. Different techniques and tools are used to make eye splices depending on the type of rope construction, i.e. three-strand, plaited, or double-braided.

Fairlead
Metal fittings which lead lines in the direction desired.

Fake (faked down)
To lay out a line in long, flat bights.

Fast
To secure, as to make fast a line to a cleat.

Fatigue
The tendency for materials or devices to break under repeated (cyclic) loading.

Fish hooks
Outer wires of wire rope that break and cause the short ends to project from the rope. Sign of wire rope deterioration.

Flounder plate
A triangular steel plate to which chain bridle legs are connected.

Grapnel
A small anchor with several claws used to recover objects in the water.

Gypsy head
The drum of the winch, around which a rope is turned, for heaving in.

H bitt
A large structure mounted on the deck or in a bulkhead used to lead or stop off a tow hawser. May be used on tugs. A head point used for towing.

Hawser
A heavy line or wire rope. Any line over five inches in circumference.

Heave around
To haul in.

Heave taut
To haul in until the line has a strain on it.

Heave to
To stop; to bring the ship to a halt, dead in the water.

In step
An expression used to indicate that the towing ship and its tow are riding the crests and troughs of waves simultaneously.

IPS wire
Improved Plow Steel wire.

IWRC
Independent Wire Rope Core. The internal strand of a multiple-strand wire rope, made up of wire strands twisted together.

Jackstay
Horizontal wire or line rigged for a special purpose to which articles such as seabags, tackles, coils of lines and small-cordage ropes can be lashed or hung.

Lay
The direction of the twist of strands of a rope.

Lay length
The distance, measured parallel to the axis of the rope (or strand), in which a strand (or wire) makes one complete helical convolution about the core (or center).

Line
A term frequently applied to a natural or synthetic fiber rope, especially if it moves or is used to transmit a force.

Locking pin
A keeper or device used to hold or maintain a chain stopper, shackle or other similar device in a designated position.

Messenger
A light line used for hauling over a heavier rope or hawser.

Monkey Fist
Weighted knot in the end of a heaving line.

Nip
A sharp bend (short turn) in a line or wire.

Padeye (horizontal, vertical)
A metal structure with a hole for a shackle or pin. On a vertical padeye, the axis of the hole is parallel to the deck. On a horizontal padeye, the axis is perpendicular to the deck. Vertical padeyes are often referred to as free-standing padeyes.

Pay out
To slack off on a line.

Pear-shaped detachable link
A special or detachable link, larger at one end, used to connect a small fitting or chain to a larger fitting or chain.

Pelican hook
A hook which can be opened while under a strain by knocking away a locking bail which holds it closed; used to provide an instantaneous release.

Pendant (pendant rig)
A single wire or chain that leads from the apex of a towing bridle to the tow line.

Preventer
Any line, wire or chain whose general purpose is to act as a safeguard in case something else carries away.

Roller chock
A chock fitted with a roller.

Rope
A group of strands of fibers or wires, twisted or braided together, to form a single pliable member.

Safety shackle
A connecting device similar to the common shackle except that a hole is drilled in the bolt to accommodate a cotter key for locking the nut on the bolt.

Screw pin shackle
A type of shackle in which the pin passes through one side of the shackle and threads into the other side to form a closure.

Shackle (anchor, chain)
U-shaped metal fittings, closed at the open end with a pin. Used to connect wire and chain to padeyes, etc. The anchor-type has an exaggerated bow; the chain-type has parallel sides.

Shot
A standard length of chain, nominally 15 fathoms (90 feet).

Slip
The space between adjacent piers.

Spliced eye
A wire rope termination formed by unlaying the rope and intertwining the strands to form an eye.

Spooling
Winding a rope on a reel or drum.

Spring
A mooring or docking line leading at an angle less than 45 degrees with the fore and aft lines of the ship. Used to turn a ship or prevent it from moving ahead or astern.

Spring-lay rope
A rope combined of rope fiber and wire.

Spring line
See Spring.

Stern line
A mooring line leading from the stern of a ship.

Stopper
A short length of rope secured at one end and used to stop it from running.

Surge load
Sudden strain on a tow line caused by the pitching, sheering or yawing of the tow or the towing ship.

Surge
To slack off a line or let it slip around a fitting.

Swage
To connect, splice or terminate wire rope by use of steel fittings, installed under extremely high pressure.

Swivel
An anchor chain component fitted to turn freely and reduce twisting and kinking of the anchor chain.

SWL (safe working load)
The load that a rope or working gear may carry economically and safely.

Synthetic tow line
A line or pendant used for towing. Made from any of a group of synthetic long fibers.

Tattletale
A length of light cord attached to a synthetic hawser in order to give warning when the load approaches the hawser's limit.

Thimble
A grooved metal component fitted snugly into an eye splice.

Tow pad
A padeye designated or dedicated for connection to the tow hawser or bridle. See Padeye.

Towing hawser
The towing member which connects the towing ship to the towed ship.

Towing pad
Large padeye to which a tow line may be attached.

Turnbuckle
A metal appliance consisting of a threaded link bolt and a pair of opposite-threaded screws, capable of being set up or slacked off. Used for setting up standing rigging or stoppers.

Veer
To pay out chain or line.

Warping (winch)
Moving a ship by hauling on a line attached to some fixed object such as a buoy or dock. A warping winch is similar to a capstan except that the warping head or heads are mounted on a horizontal shaft.

Welded chain
Chain formed by flash-butt-welding.

Wire rope
Rope made of wire strands twisted together, as distinguished from the more common and weaker fiber rope.

Wire rope pendant
A long wire strap.

REAR SECTION

NOTE

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